
Flight Training Technology for Regional/Commuter Airline Operations

Regional Airline Association/NASA Workshop Proceedings

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Edited by Alfred T. Lee and John K. Lauber

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WELCOMING ADDRESS

Clarence Syvertson

NASA Ames Research Center

DR. LAUBER: Good morning, and let me extend an unofficial welcome to Ames Research Center. You'll be officially welcomed in a few moments. I'm John Lauber. I'm the co-chairman of this workshop along with Dick Collie from the RAA. Before we begin the program, I'd like to turn the podium over to our Center director, Cy Syvertson.

MR. SYVERTSON: Thanks, John. I guess if John gave you the unofficial welcome, it's my job to give you the official welcome. We are very pleased to host this meeting. Firstly, I have a particular interest in the workshop. It was about 12 or 13 years ago, I guess, I was involved personally in a study of civil aviation that was carried out jointly by the Department of Transportation and NASA.

One of the outputs of that particular study was a recommendation for three areas of R&D emphasis, and one of those was what we called low density short haul. That's the area, I think, what we were trying to say is the area served, or the part of the air system served by regional and commercial airlines. So my interest goes back to at least that period of time. The other two recommendations that I recall was do something about noise. And I think some progress has been made in that area. And the other was do something about the congestion around the airport, and I think the economy took care of that rather than R&D.

The second interest that I have in this particular meeting is that aeronautical human factors is one area that we have chosen to emphasize here at the Ames Research Center. I think we have made some progress in the last several years understanding some of the problems in that particular area of research due to people like John and Al Chambers and the rest of the people in that division. So when both of those areas come together in a special meeting like this, it is of special interest to Ames, and we are very happy to have you here, and I hope you enjoy the meeting.

I see on the schedule there is a tour of Ames on Friday and, if you can stay, I recommend that. I think you'll find some of the things we are doing here interesting. We have a new facility just about on line called, The Man-

Vehicle Systems Research Facility which is designed to study a lot of problems associated with human factors. I hope it's on the tour; it should be.

Again, welcome and I certainly hope you enjoy the meeting and find it productive. Thank you.

Dr. Lauber: At this point, let me turn the podium over to Dick Collie. The program shows that Alan Stephen, the Vice-President of Operations for the RAA, was to make some opening remarks. Alan unfortunately was delayed in Washington. However, he will be here later this afternoon or tomorrow, and he will stay for the duration of the meeting. So Dick Collie from the RAA will represent Al Stephen this morning.

WORKSHOP OVERVIEW

Richard L. Collie, Co-Chairman
Regional Airline Association

and

John K. Lauber, Ph.D., Co-Chairman
NASA Ames Research Center

MR. COLLIE: Thank you, John. I too welcome you to the Regional Airline Association and NASA workshop on flight crew training and cockpit resource management. Al Stephens unfortunately is tied up in Washington. It seems the General Accounting Office came out last Wednesday with a new study that said small aircraft were 18 times more unsafe than large air carrier aircraft. Congressman Levitus from Georgia decided he wanted to hold hearings yesterday, and Alan spent about an hour on the hill testifying. As a result, he didn't get in last night. I understand the testimony went well, and that Alan was able to punch a lot of holes in the General Accounting Office survey. Alan sends his apologies to you.

At last count we had 63 airlines registered for the workshop which included four aircraft manufacturers, three simulator manufactures, quite a few organizations such as the NTSB, the FAA, and the Flight Safety Foundation. We have somewhere in the neighborhood of a hundred people here this morning.

I just want to go on record as saying without NASA's help and especially that of Dr. John Lauber who has done so much for the aviation industry, that we could not have put together a program that would attract such a wide, diverse group of attendees.

If you look at our preregistration list, you will see we really have a diverse group.

So, Cy and John, the RAA member airlines really appreciate your efforts and hospitality for putting on this workshop, and helping us with a problem we need to take a look at and solve. Again, thank you for your efforts.

The seeds for this workshop were planted last year in Tampa, Florida. I enticed John to give a speech on cockpit resource management. At that time we had 61 airlines represented and about 115 attendees. It became very obvious that there was a need for a workshop, a training workshop, of some sort. So here we are and I for one believe that when you leave Friday, you will have made a significant contribution to safety in air transportation, to cockpit resource management training and to state of the art flight training technology for the regional commuter airline industry.

The workshop has been designed to focus on the training requirements, state of the art training technology, advanced training concepts and cockpit resource management. The final product will be a source book of training information and ideas on training that will be made available to the industry to help foster the development of advanced training concepts.

Today and early tomorrow will be devoted to various presentations by some of the most qualified flight training experts in the country. After these presentations, the attendees will break into workshops to address special topics and workshop objectives. The chairman of each group and a select panel from that group will present a report to the attendees on Friday morning.

To obtain full benefit of these reports from the working groups we will encourage a lot of floor participation. John and I have agreed that the Friday afternoon schedule will be adjusted as necessary to accommodate floor discussion on Friday morning. So if the 1:30 schedule Friday afternoon needs to be changed, we're prepared to slip it back to as late as 3:30 in the afternoon.

During preregistration we sent out cards that asked for the first, second and third preferences on specific working groups. We gave everyone their first choice and wound up with 40 persons in group 1 and some lesser numbers in the other groups. So we went to the second choices, and it worked out pretty good.

The only arbitrary choices we made was when there was more than one person from an airline; we didn't want to put them in the same working group. We wanted to spread them out so they could obtain more benefit from the workshop.

Dale Walden is making up a new list of attendees who are here. I will go through the working groups again and if it's necessary to make some changes to balance them out, I will use the same priorities that we originally used.

There is one thing I would like to mention that I think each of the working groups should be concerned with. The new generation airplanes have various flight management systems installed. They have thrust management systems, they have computers, and you have to fly the airplanes and program them and do what the computers want, because the people who put the software in there said this is the way you have to do these things.

To quote John, maybe we need to think a little bit about the term "disconnect" training. If you have a program set in the computer and at the last minute there is a change, you need to keep somebody flying the airplane. You need to perceive that the computer is not working properly so you can disconnect it and fly the airplane manually.

I know this has happened in some state of the art airplanes. I know it has happened in some of the airplanes that members of our group operate where a thrust management system didn't function properly.

In closing, I'd like to leave you with one additional thought. If this workshop is successful, and I have no reason to believe it will not be, we will make enormous contributions to safety by developing practical guidelines for small air carriers to use in developing their training programs. It will probably be the most important and dynamic change that we're going to encounter in training concepts for many years to come. Thank you.

DR. LAUBER: Thank you, Dick. And incidentally, the reference that Dick made to a necessity for disconnect training, I don't want to take credit for that because the idea was not mine. It was a suggestion made by an individual who reported to the Aviation Safety Reporting System a specific incident that involved new technology in the cockpit and a series of problems that he felt in retrospect would clearly have been better handled had they simply turned everything off and then dealt with the problems one at a time rather than attempting to leave everything on line like they did and end up with a confusing situation.

So Dick's point regarding the impact of technology and the implications of all of that for training is an extremely important issue that I hope you people can deal with effectively during this workshop. In fact, one of our speakers this morning, Al Lee, will have some comments to make about those particular issues. It is an important issue, and I look forward to seeing what we can do to make substantive recommendations with regard to how to go about training around some of the problems that we've noted with the new technology.

Dick was very kind in thanking NASA for the assistance in putting this together, I appreciate that, but I'm simply a cog in a much larger wheel. There are many people whose efforts go into all of these workshops and into the research program itself that forms the technical basis for many of the things we will be discussing today. Not the least, of course, is Cy Syvertson; Center management has been very supportive in helping us to put on these workshops, and I truly appreciate the support we've gotten from NASA.

I think our Director for Life Sciences, Chuck Klein is in the crowd too. I think my boss, Al Chambers, is also here. Al, are you nearby? He is back at the back of the room. All of them have been very supportive. And, of course, there is a corps of NASA people who will be working with you as co-chairmen of the individual working groups when we break up tomorrow, whom you'll be meeting individually at that time.

There are a lot of people who have made inputs into this, and I'm very pleased to be a part of it. And, like Dick, I look forward to producing some information and some output which is going to prove useful to your industry as a whole in all of this thing. Dick has really done a very good job, I think, of summarizing the objectives and particularly his latter comment with regard to the necessity to produce information that can be applied by the regional and computer airline industry to training problems, and this is what this whole workshop is all about.

We've arranged a program which, as you all know, has a series of presentations from people who are experts in various areas that we are going to be discussing today. But the real output, the real product of the workshop is going to come from the individual working group sessions. The principal purpose of having all of the presentations today and early tomorrow morning is to provide grist for the mill to stimulate thought, to stimulate the exchange of ideas, to get you all thinking about problems, what are the issues and what are some of the potential solutions to those issues and problems. It's from those individual working groups that the real product comes.

The reports that you'll be generating during your deliberations tomorrow and reporting to the general assembly when we get back together Friday morning constitutes the basic output of this workshop. As Dick said, the objective is to produce a set of guidelines or a source book of information regarding training problems -- flight crew training problems -- which is specifically directed to the unique world faced by the regional and commuter airline operators.

This, as you know, is one of a series of workshops that NASA has co-sponsored with industry. The others have been with the major air carriers. There are a couple of people here who were very instrumental in developing the whole concept of a NASA/industry workshops. The first one we did, in June of 1979, was on cockpit resource management. Both of those people are with us. George Cooper and Maury White, would you please stand? They were very instrumental in helping pull together the concept of these workshops and helping us get started in that direction. So much of what is going to happen and much of the success of the past workshops, and hopefully the success of this present one, is because of the input that George and Maury made during that early period of time.

With that I'd like to go directly into the technical part of the program and introduce our first speaker. Paul Caro is an individual that I've known for many years. In fact, 13 years or so ago, when I was a naive, young, fresh Ph.D. out of graduate school, I went to work for the U.S. Navy down in Orlando, Florida, at the Naval Training Equipment Center. One of the first people that I ran into there was Paul Caro, who at that time worked for Humrro at Fort Rucker doing work in helicopter simulation and training.

Paul is, in my mind at least, the resident expert in the application of simulation and training technology in general practical training programs. He is currently a program manager at Seville Training Systems in Pensacola and has been involved in the design, development and evaluation of pilot training equipment and courses of instruction for most of the past 25 years.

The products of his efforts include the Army's flight simulators and the Coast Guard system for training search and rescue helicopter pilots. While the majority of his work in pilot training has been for military systems, he has also developed and evaluated training programs for major airlines and is currently responsible for the development of the courseware for Simu Flite Training International.

Paul holds a PhD degree in industrial psychology and psychometrics. He is a fellow of the American Psychological Association and the Human Factors Society, and a member of the Association of Aviation Psychologists and the AIAA. He is also a member of the Air Force Scientific Advisory Board and chaired a recent panel that evaluated training within the Military Airlift Command.

With that, I'd like to turn the podium over to Paul Caro for presentation and an overview of training technology and the application to pilot training programs.

FLIGHT CREW TRAINING TECHNOLOGY---A REVIEW

Paul W. Caro

Seville Training Systems

There is a technology of flight crew training. It is based upon human learning processes, and it involves the manner in which information, cues, and practice opportunities are presented to a learner. In pilot training, the term "training technology" has been closely associated with the use of simulators, generic training devices, and various classroom training aids. We must not be misled into thinking that these equipment items comprise training. In fact, they do nothing more than provide convenient means by which information can be presented, cues can be manipulated, responses can be practiced, and guidance and feedback to the student can be controlled.

This paper devotes a good bit of attention to simulators and other training equipment, but the most important message it contains is that pilot training is a process that is not dependent upon costly training equipment. Such equipment may be an important factor in making the training process easier to administer and control, but the single most important factor in efficient and cost effective training is the training process, that is, the way in which equipment and training resources are used to present information and cues, and to provide and reinforce practice.

In the good old days, pilots learned to fly in airplanes. Not a lot was known then about how skills are learned, and pilot training was largely a process of self-instruction and surviving. In the French Foreign Legion prior to World War I, for example, pilot training consisted primarily of lectures by instructors on the ground and solo practice in single seat airplanes. An instructor did not fly with a student until the student had mastered basic airplane maneuvers and had completed a solo cross-country flight. Each trainee was on his own to find the cues necessary to aircraft control and to work out and practice responses to those cues that would enable him to survive each flight. The trainee could figure out the consequences of his responses, but, without an instructor on board there wasn't much guidance to keep him from making mistakes while he learned. Under such trial-and-error learning conditions, training was expensive, particularly when measured in terms of broken bones and airplanes, and trainees killed (Footnote

1).

Not all pilot training was conducted solo, of course. In the beginning, so to speak, the Wright brothers gave dual instruction to would-be pilots who purchased their airplanes, but the brothers did little more than function as safety pilots while their trainees learned to fly through trial and error, much the same as was done in the Foreign Legion. One would hardly describe such experiences as applications of training technology.

But the beginnings of a technology of flight training were emerging. The Foreign Legionnaires discovered that a plane with little or no fabric on its wings made a pretty good ground training device. In such a device, pilots could at least learn a little about aircraft handling while taxiing fast without the danger of becoming airborne before receiving the first lecture on takeoffs and landings.

Other, more imaginative, people were also attempting to advance the technology of flight training. The device shown in Figure 1 is an early generic flight trainer. There is no surviving evidence that it was effective. Like a lot of training devices used in flight training today, it filled a block of time in a training program. Since it did that quite well, its effectiveness probably was not seriously questioned.

We sometimes think that training technology was invented by pilots. That is not true. The need to provide training even when operational equipment could not be used for that purpose has been around for a long time and in many areas of activity. For example, General Wood resorted to simulation when horses were not available to train his troops, as is shown in Figure 2. Similarly, flight training devices probably would not even have been developed if it were not for the fact that dual-control training aircraft were not available and solo flight training was inefficient and presented unacceptable risks to trainees and equipment.

One might debate whether General Wood invented a horse simulator or a generic trainer. The issue, presumably, is whether he had simulated a particular horse or a more general class of animals that might have included mules.

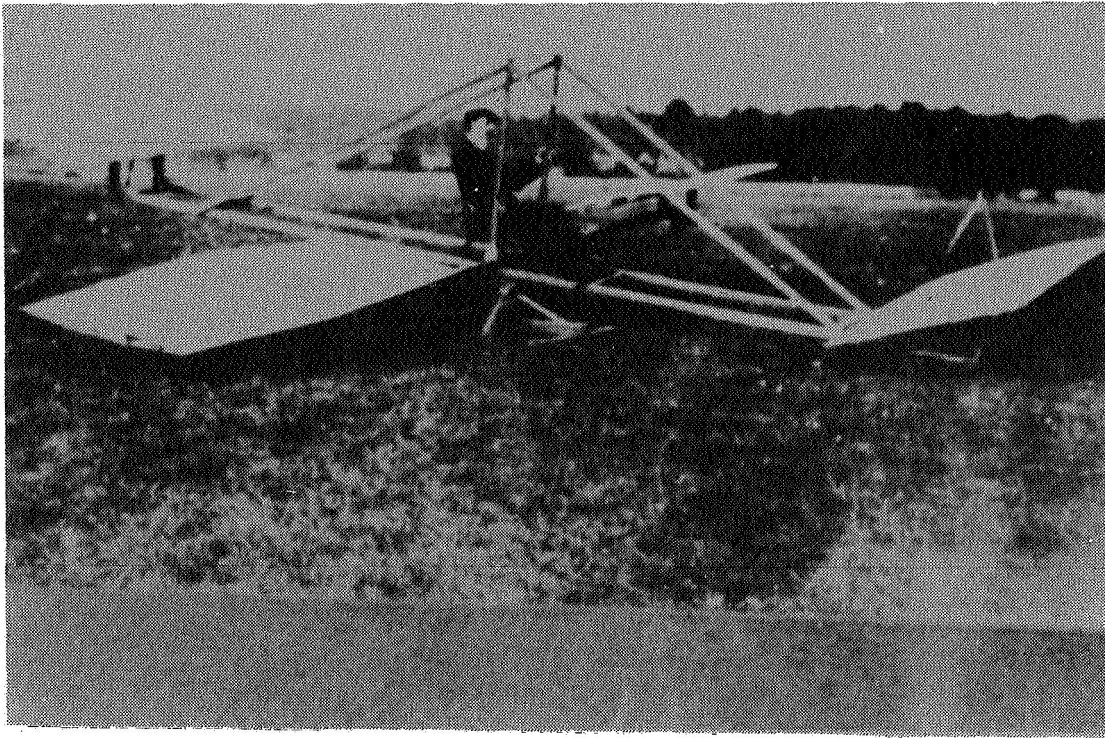


Figure 1.- An early flight training device.

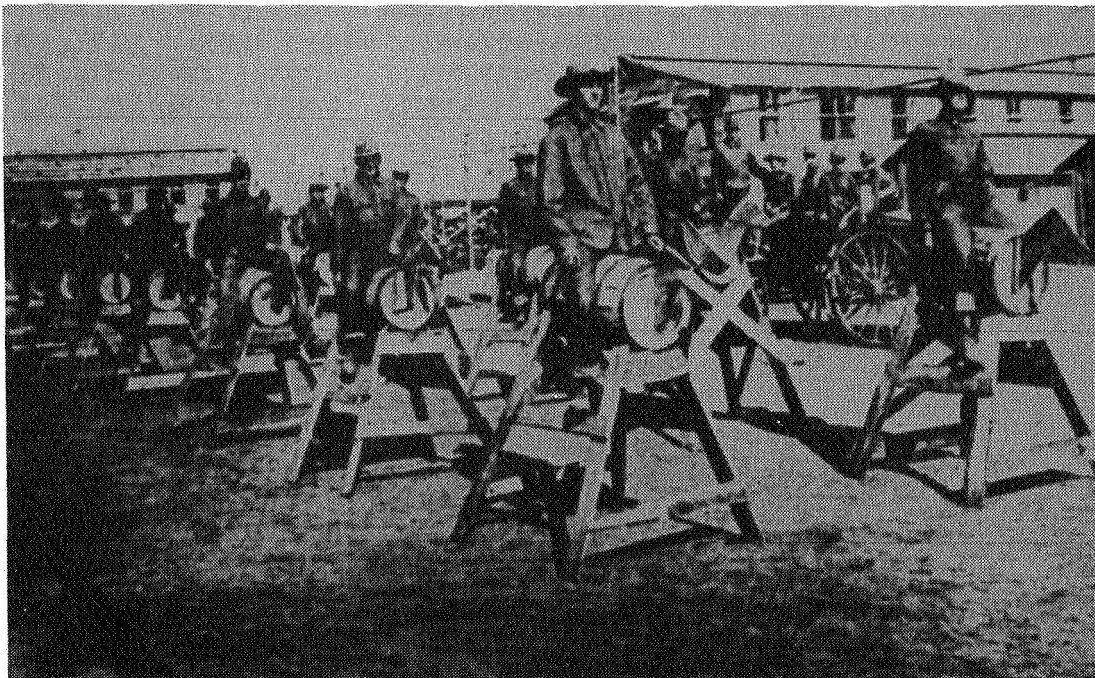


Figure 2.- General Wood's troops training on simulated horses.

His device probably should be classified as a simulator. The evidence suggests that he was attempting to make it as much like a horse as available technology and resources would permit, because he thought that realism is necessary in training.

The concept that realism is necessary to transfer of training, that is, to assure that training received in a trainer will transfer to operational equipment, underlies the design and use of training simulators even today. The concept is based upon a theory by an early psychologist, Edward L. Thorndike (1931). His theory would suggest that transfer will occur to the extent a simulator and the equipment simulated share common elements. A later theorist, Charles E. Osgood (1949), developed a "transfer surface" based upon a common elements theory. Using Osgood's transfer surface, one could map an assumed relationship between elements or features of a simulator onto the equipment simulated. Where there is one-to-one correspondence, according to Osgood, transfer of training will be positive and high. Less than one-to-one correspondence will yield decreasing transfer, to the point that none will occur.

From these theories, it was an easy step to assume that physical correspondence between a simulator and the system or equipment simulated was the key to transfer of training. Largely for this reason, the evolution of simulation became primarily a matter of technological advancement to make simulators realistic, accurate, and comprehensive representations of a particular system. Some people refer to realistic simulators as "high fidelity".

In 1929, Edwin A. Link introduced the forerunner of modern flight training simulators (Figure 3). The influence of the then-current theories concerning realism and training effectiveness are evident in its design. Although the Link trainer was used primarily to teach instrument flight, the device was made to look like an airplane, complete with wings and tail. Even when Link later added a hood to his device's design to make it a more realistic instrument trainer, the wings and tail were retained. This basic device, complete with wings and tail, was widely used in military flight training programs during World War II (Footnote 2).

Following World War II, training technology evolved to the point that the need for some of the realism that

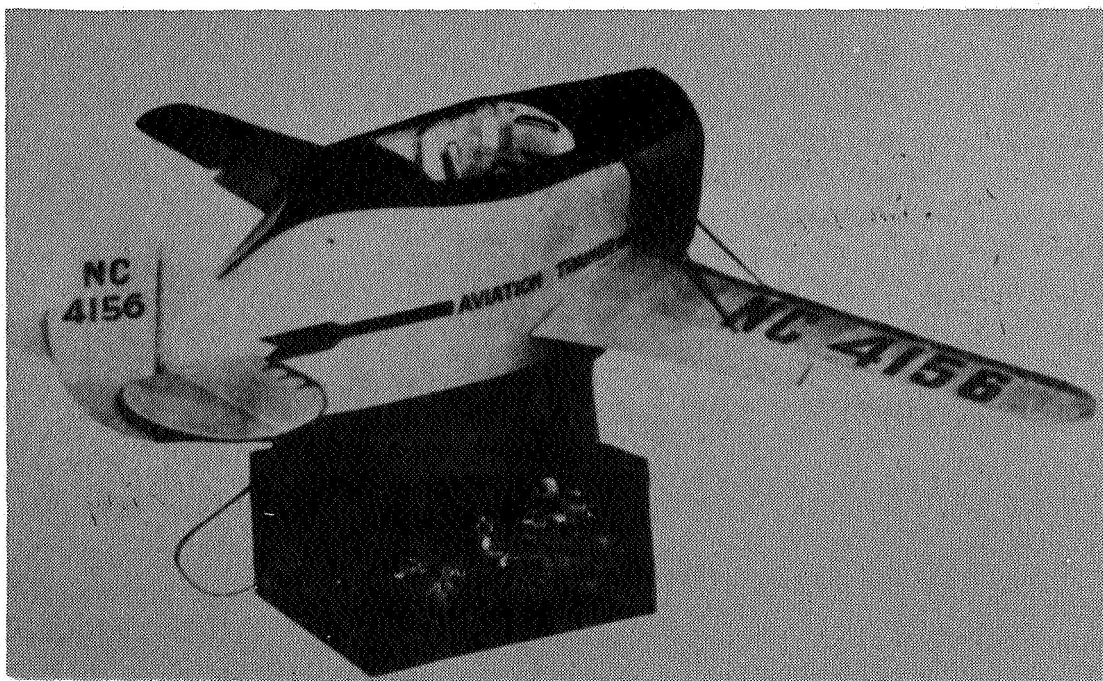


Figure 3.- 1929 flight trainer by Edwin A. Link.

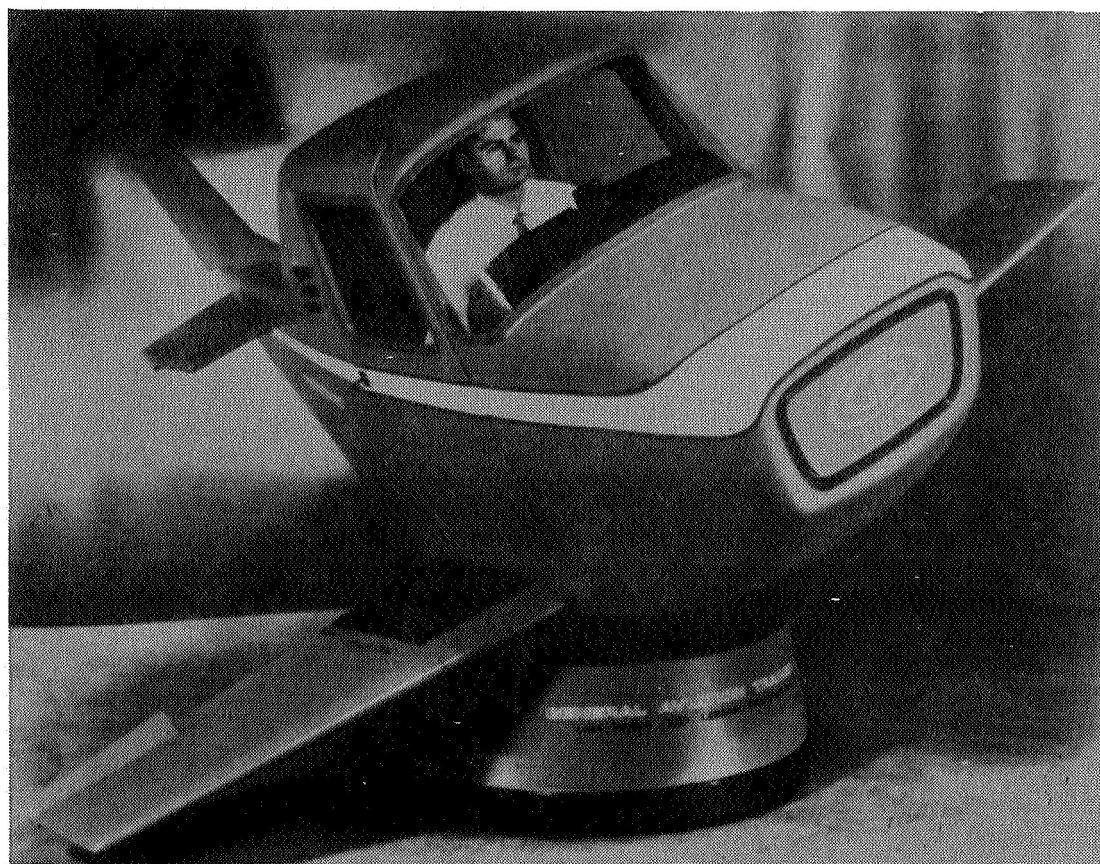


Figure 4.- Link GAT-1 trainer.

characterized flight training simulators was being questioned. The relevance of some simulator features to the training objectives, such as the relevance of external structures of the airplane to instrument training, was not obvious, so such features were omitted. However, the realism inside the cockpit or in the simulated flight characteristics was not being questioned. The only limitations there were the state of engineering art.

Even then, it was not possible to simulate a particular aircraft with high realism. The Link trainer of the early post-war era was an instrument trainer that simulated the instrument environment. It responded to pilot input with many of the characteristics of airplanes, but it did not simulate with any accuracy a specific aircraft. It was a generic trainer rather than a simulator.

In the 1950s, training devices were viewed as increasingly important due to the rapidly increasing complexity of aircraft and the corresponding increase in the complexity and cost of pilot training. It was reasoned that more realistic training devices would produce increased transfer of training. Consequently, attempts were made to develop devices whose features corresponded precisely to features of specific aircraft.

Thus, the modern flight simulator was born, at least conceptually. Because of engineering limitations at the time, these simulators were more realistic in cockpit appearance and switch functions than in flight characteristics. Extra-cockpit visual displays began to appear at about the same time, so the training to be conducted in the new simulators was not limited necessarily to instrument flight. Motion simulation was not new, of course, having been included in the design of the very earliest flight training devices (e.g., see Figure 1).

As we came to recognize the potential of simulators, the transfer of simulator training to the operational equipment was more and more the critical issue in using these devices. Accordingly, pilot training technology became increasingly dependent upon Thorndike's common elements, a theory which suggested an objective basis for designing transfer into simulators. Aircraft-specific simulators began to replace generic training devices. There were some who resisted the trend, however, primarily because simulators were becoming increasingly costly, and several companies developed relatively low-cost generic flight trainers. For example, Ed Link's company updated one of its earlier product designs, complete with wings and tail (Figure 4), but generic trainers had relatively little appeal to pilots who had begun to expect high realism in simulators. Nevertheless, some of these devices were used

effectively in a few pilot training programs. One, for example, a generic trainer for twin-engine airplanes, was demonstrated to be effective when used in a highly structured training program with specially trained instructors. In fact, even though it had no visual display, training in it was shown to reduce by about half the time required for subsequent transition training involving visual flight maneuvers and landings (Caro, Isley, and Jolley, 1973). The acceptance of generic training devices by the flight training community increased when their cockpits were configured like specific aircraft, thus presumably increasing the number of common elements they shared with the aircraft simulated.

Probably no one was more convinced that Thorndike's common elements theory was the real basis for the effectiveness of simulator training than were the people in the Federal Aviation Administration. If a simulator did not look, feel, smell, and bounce around like the aircraft simulated, the FAA apparently reasoned, its transfer of training value had to be low. Consequently, realism became the major factor in the design of simulators for the airlines, and airline design practices were soon reflected in military simulators as well. Even with respect to motion, realism was the goal, limited only by the rates of movement and physical displacement that could be provided within manageable spaces. Similarly, as soon as visual technology permitted realistic appearing airport scenes to be simulated, FAA rules were made to permit more training to be conducted in simulators that had high realism in visual scenes.

But is all that realism and cost really necessary to effective pilot training? The answer to that question is both yes and no. Yes, realism is necessary if we choose to rely upon it instead of training technology, and if our training programs resemble those of the French Foreign Legion in World War I; that is, if our simulator training consists of turning a pilot loose to figure out, more or less on his own, how to fly, or even if we give him an instructor who teaches in the simulator just as he would in the aircraft. However, if we are willing to use simulators in ways that are not dependent upon their physical correspondence to aircraft, the answer is no, realism is not necessary for much of the training pilots must receive.

Studies involving simulators of intentionally low realism have demonstrated that effective training can be conducted in low-realism devices (Grimsley, 1969). In fact,

at least for some tasks, training in low-realism simulators has enabled pilots to perform as well in aircraft as could other pilots trained in high-realism simulators, or even in the aircraft themselves (Prophet & Boyd, 1970). In these studies, the low-realism simulators had training value equal to that of very high-realism simulators.

More will be said in this paper about low-realism simulators. First, it is necessary to define a few terms that will help one understand why low-realism simulators can have such high training value.

Pilots depend upon cues to assess the status and conditions of their aircraft, to initiate actions, to guide their performance, and to signal when an action should be altered or ended. An important concept in flight training technology, then, is the concept of cue and the distinction which exists between a cue and a stimulus. Stimuli are the bases for cues, but a stimulus is not a cue by itself. The term "stimulus" refers only to a physical object or event than can activate a sense organ. The illumination of a light on an instrument panel is a stimulus that is sensed by the eye. Movement of a control wheel provides pressure that is sensed by nerves in a pilot's hand and arm. The training task is to learn the meaning of such stimuli, to derive pertinent information from them, so that the proper response can be made.

As these meanings are learned, stimuli become cues. In other words, a cue is a stimulus that has acquired meaning. A panel caution light, for example, conveys information that is understood by the pilot. The goal of pilot training is to learn the informational content--the cueing value--of task-relevant stimuli so that precise actions can be taken. This role of cues, as opposed to stimuli, has a major implication for simulator design and use. The implication is that cue information available in a particular simulator, rather than stimulus realism per se, should be the criterion for deciding what skills are to be taught in that simulator.

Skilled pilot performance is dependent upon making appropriate responses to cues. Therefore, the two most important training technology considerations are how one learns to interpret cues, and how one selects the correct responses to be made to those cues. Interpreting cues and selecting appropriate responses involves a process called discrimination. Discrimination is the recognition that a given stimulus or response has a meaning different from that of another stimulus or response. Although two lights on the panel may be physically identical and have the same stimulating effect upon the pilot's eyes, he must discriminate between these lights and make a unique response to each when it illuminates.

The simplicity of this definition of discrimination should not suggest that discriminations are simple processes, or that they can be easily learned. The more complex the skill, the larger the number of moment-to-moment discriminations that must be made. Also, as task complexity increases, discriminations may depend upon very subtle differences in entire patterns of numerous stimuli. The discriminations that must be learned when practicing landings in a new aircraft or during cockpit resource management training, could be quite numerous and complex. For tasks that involve execution of relatively fixed procedures, the discriminations might be less numerous and complex. The principal difference between a novice and an expert when performing complex tasks is that the expert has learned to discriminate subtle stimulus differences that a novice cannot. He can also translate the subtle meanings of such stimuli into equally subtle control movements or other responses.

Another term that is important to an understanding of training technology is generalization. Generalization refers to the use of previously learned skills in situations that are different from the situations in which they were learned. For example, engine run-up procedures learned in a low-realism cockpit mock-up can be generalized to, that is, performed in, a high-realism simulator or in an actual airplane. They can be performed even though the two may differ considerably with respect to actual stimuli, because the meanings of cues present in the mock-up are similar to the meanings of corresponding cues present in the aircraft.

In fact, all cues learned in simulators can be generalized to, that is, subsequently utilized in, aircraft to the extent that the cues have the same meaning in both the simulator and the aircraft. The physical stimuli can vary. Instruments can be of different sizes or configurations; visual displays can resemble geometric patterns more than real-world scenery or can use symbols to represent objects; platform motion systems can be restricted to accelerations of brief duration and movements of small distances. After all, even the most sophisticated simulator provides at best a low-realism representation of many of the real-world capabilities of the aircraft simulated. Therefore, the training given in the simulator must concentrate upon cues and responses that can generalize to the aircraft and its mission. To the extent that appropriate cues and responses cannot be represented in a particular simulator due to technology or cost limitations, the skills associated with them must be learned in the classroom, in other devices, or in the aircraft itself.

About twenty years ago, the Army bought a very high

realism procedures trainer for a new twin turbine powered aircraft (Figure 5) and asked us to assess its transfer of training value. We agreed to do so, but in addition, we used our knowledge of the training technology concepts reviewed above to construct a low-realism mock-up of the cockpit of the same aircraft (Figure 6) so that its training effectiveness could be compared with that of the considerably more expensive Army device.

The mock-up was made of plywood, dowel rods, and photographs. The material cost about \$30, and it was constructed by unskilled labor. Physically, it was very unlike the aircraft it simulated. However, by careful design, it contained stimuli that could serve as cues to the procedural tasks that could be performed in the high-fidelity trainer the Army had developed. The responses to cues that were required in the aircraft could be practiced in the device.

The training program used with the mock-up differed slightly from that used with the more expensive Army trainer. The mock-up program emphasized the discriminations that were to be learned and the meaning, or cue value, of the physical features of the mock-up. It also called the trainee's attention to the generalizations that would be required in order for him to perform correctly in the aircraft after being trained in the mock-up.

The trainees were Army pilots who were qualified to receive transition training for the new airplane. None of these pilots had previous experience flying turbine powered aircraft. Three equally experienced groups of pilots were used during the evaluation of the training effectiveness of the two devices. One group was trained entirely in the Army-developed trainer, one group in the mock-up, and one in the aircraft itself. In addition, of course, each group received ground school instruction relevant to the tasks they were being trained to perform.

Following their training in the device or in the mock-up, each group was given a performance test in the aircraft, and its performance was compared with group trained only in the aircraft. The results are summarized in Figure 7 (Prophet & Boyd, 1970). The groups trained in the trainer and in the mock-up made just about the same number of errors during each training trial. On their first attempt to perform the procedures in the aircraft, which occurred after five training trials in the respective devices, their performance was about equal to the performance of the group

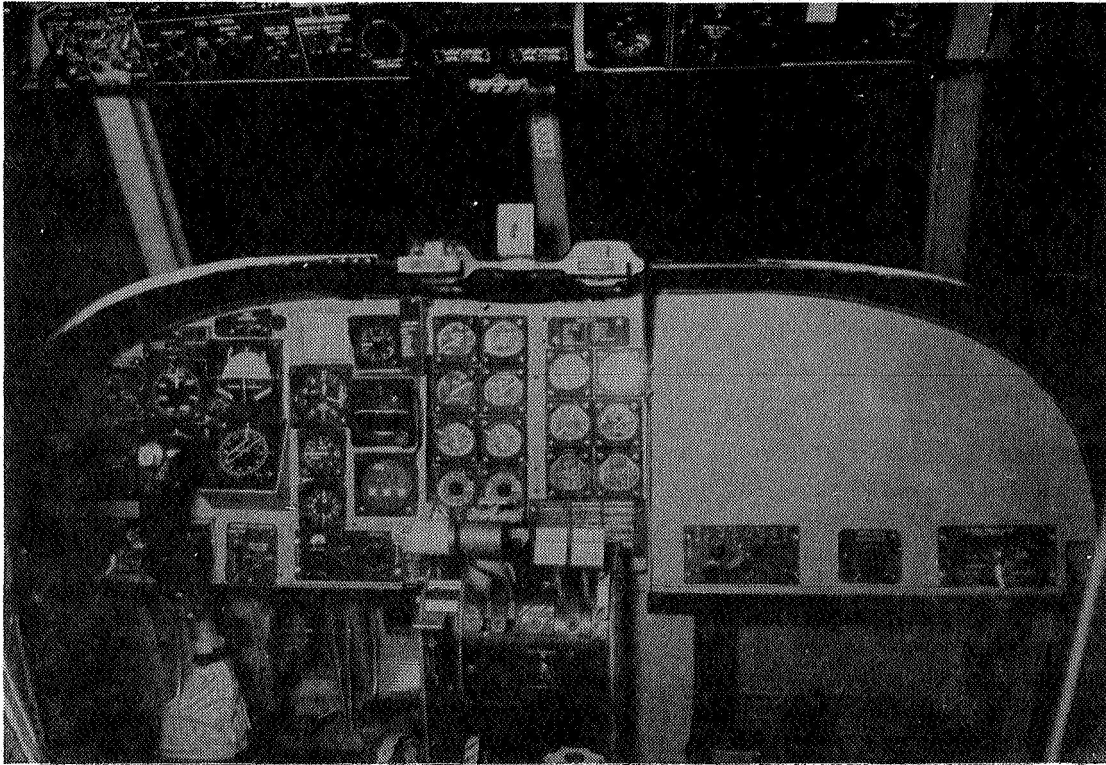


Figure 5.- Cockpit procedures trainer for U.S. Army OV-1 aircraft.

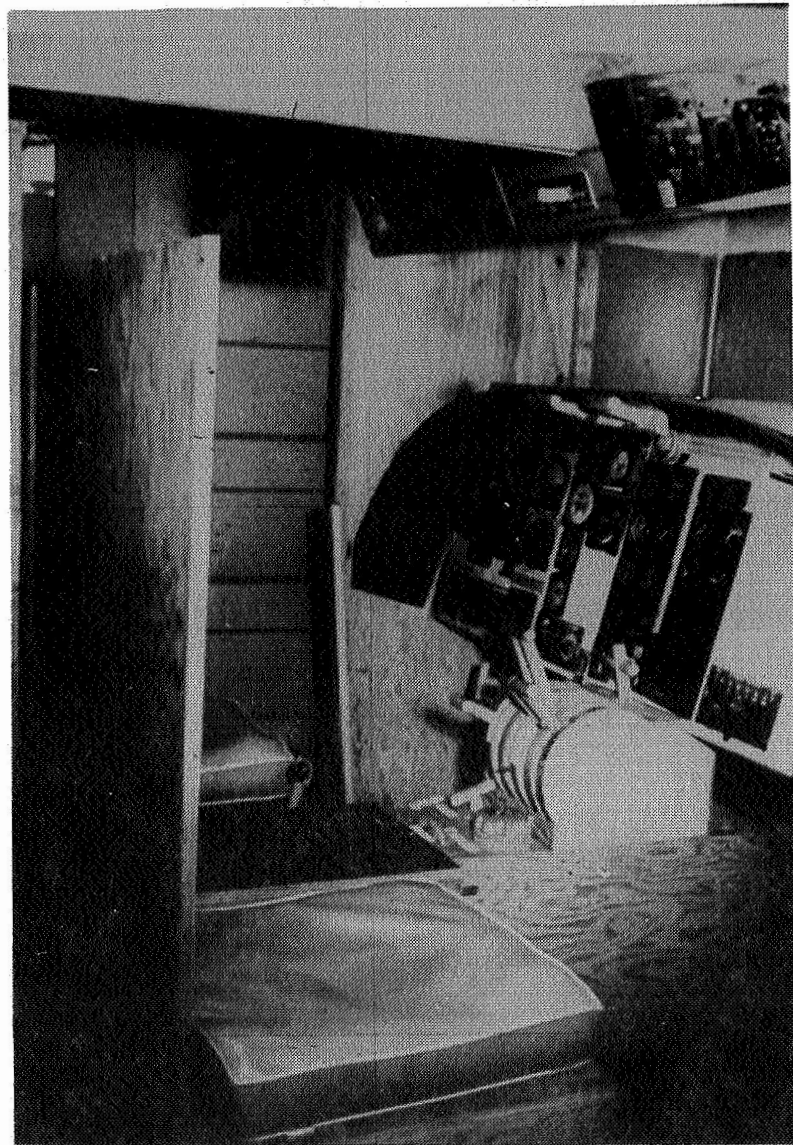


Figure 6.- Low-cost cockpit mock-up for OV-1 aircraft.

who had received all five of its training trials in the aircraft. Thus, the transfer of training value of these two simulators was essentially equal in spite of their wide discrepancy in physical realism. Further, the training received in either device was essentially as good as the training that could be provided in the aircraft.

Please note that both of the devices used in this study were simulators, not generic trainers. That is, they were designed to simulate precisely the cues and responses appropriate to a specific aircraft. Generic trainers should not be expected to result in the very high levels of transfer shown here, since the discriminations appropriate to a specific aircraft cannot be learned easily in generic trainers. The value of a generic trainer is more or less proportional to the extent of its similarity to the aircraft to which part-training performance is intended to generalize. The greater the dissimilarity, the more difficult it becomes to train the discriminations that will be required in the part-training aircraft.

Another example of a low-realism simulator is shown in Figure 8, although it is somewhat more realistic than the mock-up just discussed. This one cost about \$4,300, including material and labor (Footnote 3). This simulator is a procedures trainer for the King Air airplane. None of the instruments or controls in this device are real. They are either photographs, molded plastic, or plywood, painted to resemble components of the airplane. Unlike the mock-up shown in Figure 6, the panel lights function on this device, a few in response to movement of specific controls, as they would in the aircraft. When the wiring got too complicated for the carpenters who built this simulator, switches were provided so an instructor could turn lights on and off, as appropriate, to trainee control movements and system conditions. Except for these lights, the simulator had absolutely no dynamic features.

But it had a feature that made it unlike any other airplane simulator. All of the instruments had pointers or other indicators that could be positioned manually by the trainee. When, for example, during engine start procedures, the trainee advanced the condition lever to the high idle position, he would also reach over to the N_1 indicator and set the pointer to 70%. Since the pointer would rise automatically to 70% in the aircraft in response to movement of the condition lever, the trainee's action in the

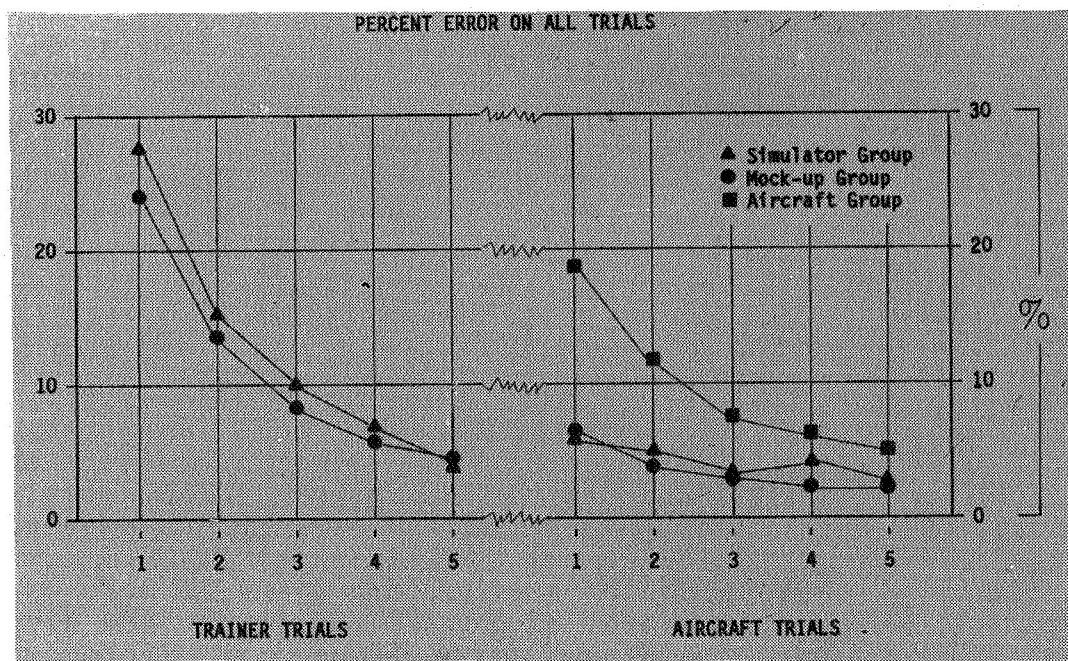


Figure 7.- Comparison of performance of pilots trained in a cockpit procedures trainer, in a cockpit mock-up, and in the aircraft simulated.

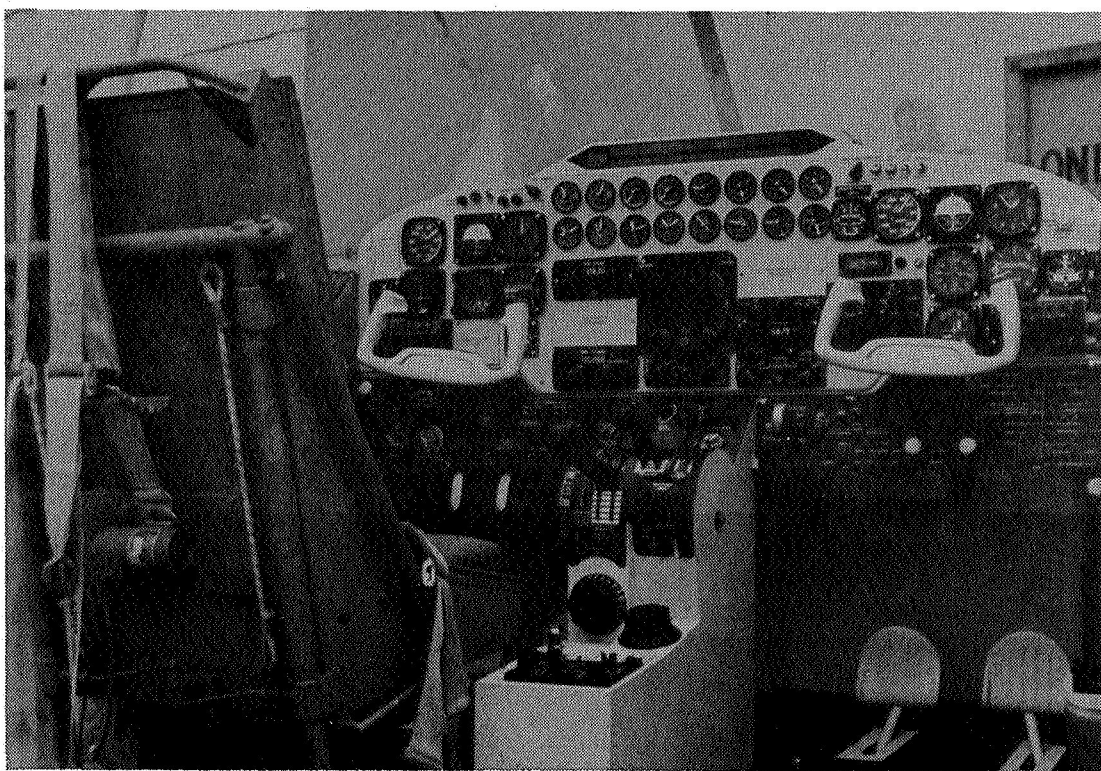


Figure 8.- Low-cost procedures trainer for the King Air.

simulator involved an intermediate step that was not necessary in the aircraft--the step of manually setting the pointer. However, the intermediate step enabled the trainee to practice the task to be performed in the aircraft, and also enabled the instructor to verify that the trainee did know precisely the value he should attain through movement of the condition lever.

During subsequent performance of the engine start procedures in the aircraft, the intermediate steps learned in the simulator rapidly disappeared, because they were no longer needed. During the first trial in the aircraft, the trainee would move the condition lever to the high idle position, reach over and touch the N_1 instrument, and verify that the instrument read 70%. During the second trial, he only pointed to the N_1 instrument. By the third trial, all of the intermediate steps had dropped out, and his performance was totally appropriate to the aircraft.

The intermediate steps that were performed in the simulator are known technically as mediators. That is, they come between, or mediate, the link between stimuli, cues, and responses. But a mediator is not necessarily an overt act such as physically positioning a pointer. A mediator can be a word, phrase, or thought that helps a trainee connect a cue with a response or associate meaning with a particular stimulus, as in a verbal or other response that substitutes in training for a nonverbal action that must be taken subsequent to that training. In brief, it is an understanding of cues and responses, and how they are to occur.

Another King Air simulator is shown in Figure 9. It is 4/10 scale and is printed on a single sheet of paperboard, ready to be cut out and assembled as shown. Transitioning pilots with no prior turbine experience, with the aid only of the aircraft flight manual, have been able to learn all the procedures associated with operation of the King Air using this simulator (Caro, Jolley, Isley, and Wright, 1972). In doing so, they have made extensive use of verbal mediation to discriminate stimuli, to establish cue meanings, to practice operation of the aircraft's controls, and to anticipate the generalizations that would occur during subsequent performance in more realistic simulators or in the aircraft itself. Through mediation, demonstratable transfer of training can be obtained by mental rehearsal of discriminations to be learned, of controls to be activated, and of switches to be repositioned. In fact, in a carefully structured and administered training program, such training can be just as effective and efficient as actually performing the procedures involved.

We are currently employing a higher technology version of the paper simulator concept which consists of an image on a computer display. With computer simulation, images are generated electronically and displayed on a video terminal, as is illustrated by the photograph of a computer-generated image in Figure 10, instead of printed on paperboard. The graphic appearances of the aircraft cockpit panels simulated is similar in both instances, although display size limits the computer simulation to a portion of the cockpit in order to present cues in sufficient detail to permit necessary discriminations to be made. In the example shown in Figure 10, only the fuel system controls and relevant display panels are included in the simulation. Thus, it is a fuel system simulator rather than a more complete aircraft simulator.

Using a computer, it is easier to represent the dynamics of the system being simulated than is the case with a paper simulator or some other low-realism approaches. Mediation is still required, however. The responses to be learned or practiced on such a simulator can be mediated through a keyboard, a light pen, or a touch-sensitive screen. In the simulation shown in Figure 10, for example, touching simulated panel switches results in their being repositioned with resulting simulation of fuel system dynamics, just as would occur in the aircraft were the actual switches similarly repositioned.

The simulation depicted in Figure 10 was generated through a computer program using the computer's graphic display capability. Current technology also permits the same kinds of simulation employing other image sources, including television. Simulations that use interactive videodiscs operated under computer control and in conjunction with touch-sensitive panels permit more realistic looking aircraft controls and displays to be used, as illustrated in Figure 11. By employing the mediating response of touching the proper portion of the image of the panel of a display generated from either computer or videodisc sources, a simulated switch may be repositioned (assuming use of a touch-sensitive screen). For example, the image of the lamp check switch in Figure 11 was used to simulate performance of the lamp check task, producing the display shown in Figure 12. (The location of the activated switch has been highlighted in this example to call the reader's attention to it.)

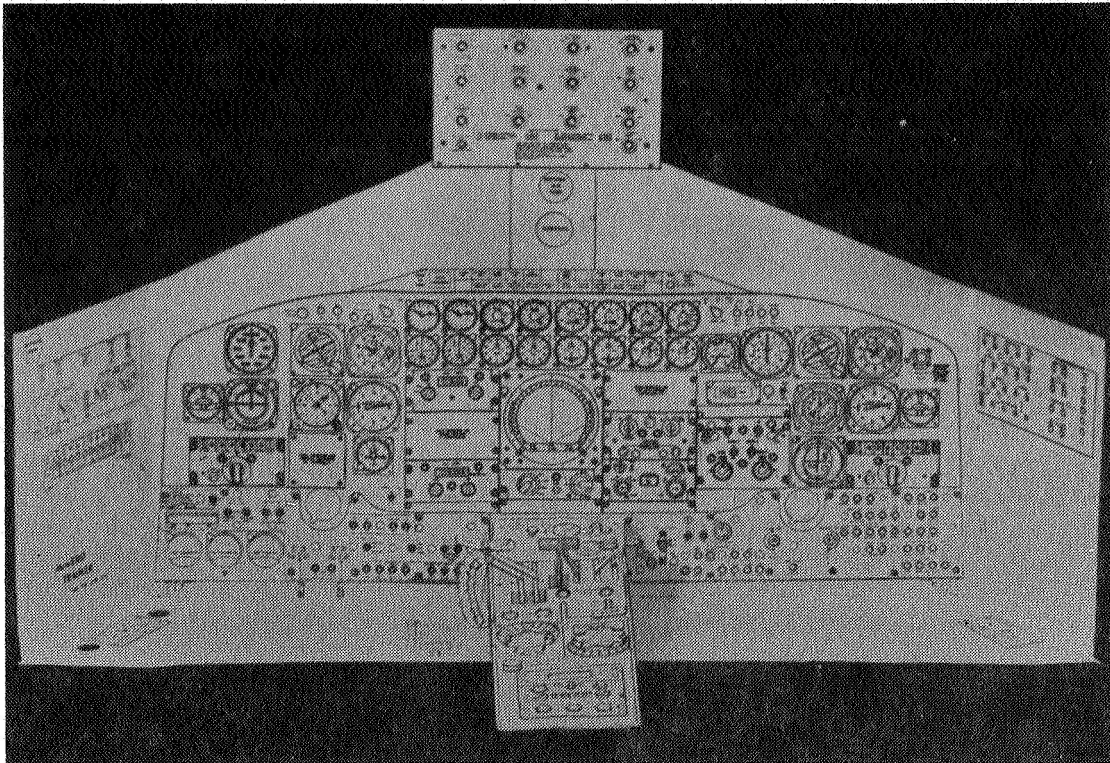


Figure 9.- Paperboard procedures trainer for the King Air.

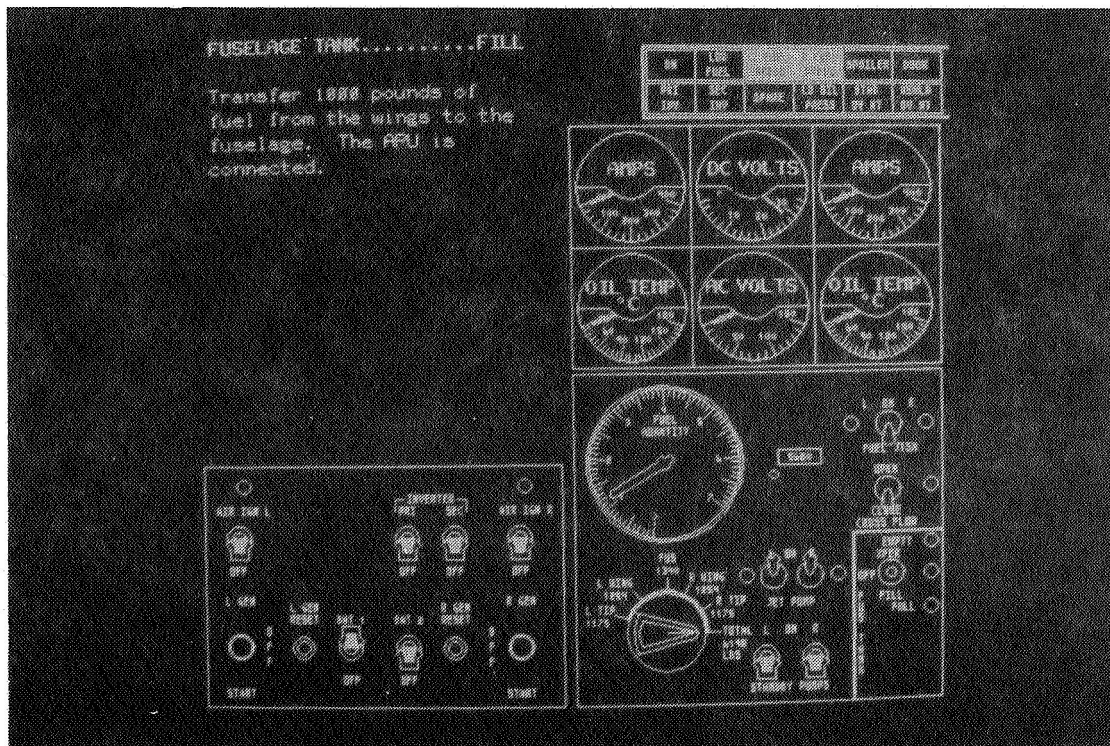


Figure 10.- Computer simulation of an aircraft fuel system.

The panel shown in Figures 11 and 12 was drawn on a graphics computer designed for that purpose. It is not a photograph, video image, or example of board art, although either of those approaches could have been used to generate a picture of a panel or display of interest. We have found that the computer-generated graphics approach to the creation of panel images such as shown here has significant development time and cost advantages for some simulation applications.

Stand-alone procedures and other part-task training devices are becoming much less common in pilot training. Simulations consisting of less costly and equally effective computer and interactive video disc display units are taking their place. With proper attention to the design of simulations employing these new technologies, and to the mediational process to be used with them, pilot training will be increasingly cost effective in the future.

That is not to say that flight simulators are things of the past. In fact, although not essential, they are becoming increasingly important in pilot training, and for at least two reasons: first, the state of the simulator engineering art is sufficient to produce devices in which complete and very realistic flight training for line operations can be conducted; and second, such training can be conducted much more efficiently and under better control in simulators than is possible in aircraft. Although an increasing portion of pilot training in the future will be conducted using computers and video display units, the need will remain to provide whole-task training, that is, training that will integrate the various procedural, psychomotor, and cognitive skills learned using part-task simulations into the total skill requirements of the line pilot. That integration training will have to take place in a vehicle in which the whole task can be performed. That vehicle must be either the line aircraft itself or a very good whole-task simulation of it. Increasingly, whole task simulators are becoming the preferred device for such training.

Realism in visual simulation has not yet been addressed, but the same training considerations apply. The present state of the art in outside-the-cockpit visual simulation is based upon computer-generated imagery. Simulated visual scenes are becoming increasingly realistic, in large part because FAA requirements for Phase II and III simulators are based upon the common elements understanding of training effectiveness. Full daylight scenes that will meet those requirements are expensive. However, very good training can be obtained using less expensive night scenes

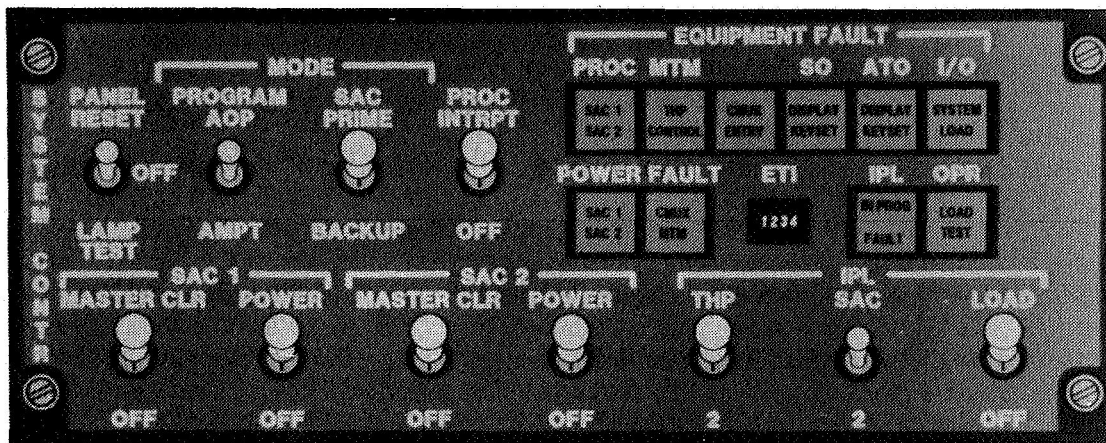


Figure 11.- An aircraft control panel created by computer generated graphics for display via videodisc.

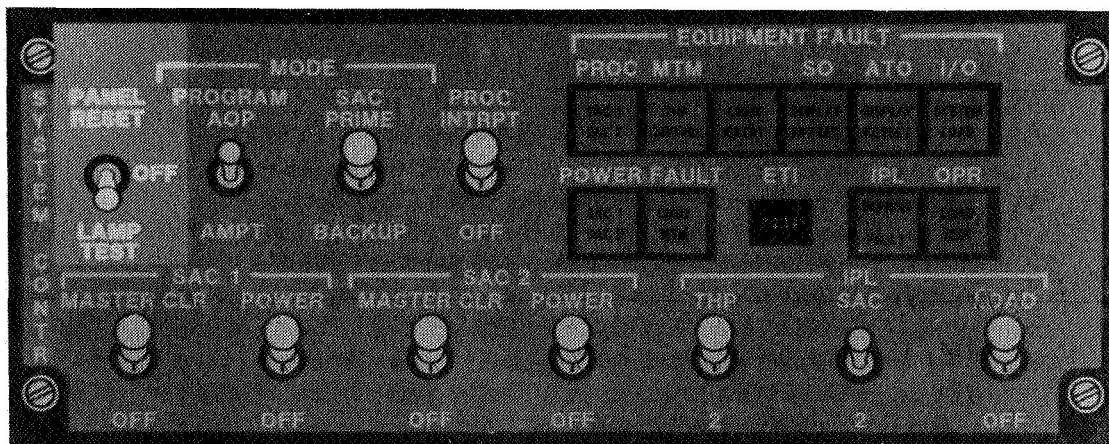


Figure 12.- Panel depicted in figure 11 with lamp text switch activated (original in full color).

such as that in Figure 13. The important cues to which a pilot must respond in practicing take-offs and landings can be presented in scenes such as in Figure 13.

Airports consist of man-made geometric patterns and points. Simulation of these patterns and points provides sufficient cues to permit practice of take-off, circling, and landing tasks. In fact, effective training of visual maneuvers has been demonstrated using even much simpler displays. Over 30 years ago, for example, researchers at the University of Illinois demonstrated that a runway pattern drawn on a blackboard, and tilted manually as a trainee simulated flying traffic patterns and landings, as is illustrated in Figure 14, provided transferable training (Flexman, Matheny, and Brown, 1950). Verbal mediation played an important role in that visual simulation.

By now, you should have gotten a message. The attention paid in pilot training programs to training process considerations makes a big difference in the cost and complexity of the training equipment needed. Realism is nice to have, even necessary for some training, but it adds cost to an already costly enterprise. A major part of the training required by pilots can be conducted using relatively low-realism, low-cost simulators. If you are results oriented and willing to attend in detail to how training is structured and administered, you can have effective training at affordable cost.

So far this paper has addressed simulators and how they are designed and used. Another aspect of cost effective pilot training, of course, is the content of that training. A characteristic of most pilot training is that its content is more comprehensive than is needed in some areas, while somewhat thin in others. There is a tendency to go overboard in developing pilot training programs, particularly where systems knowledge is concerned, because of the very real dangers of providing too little training,

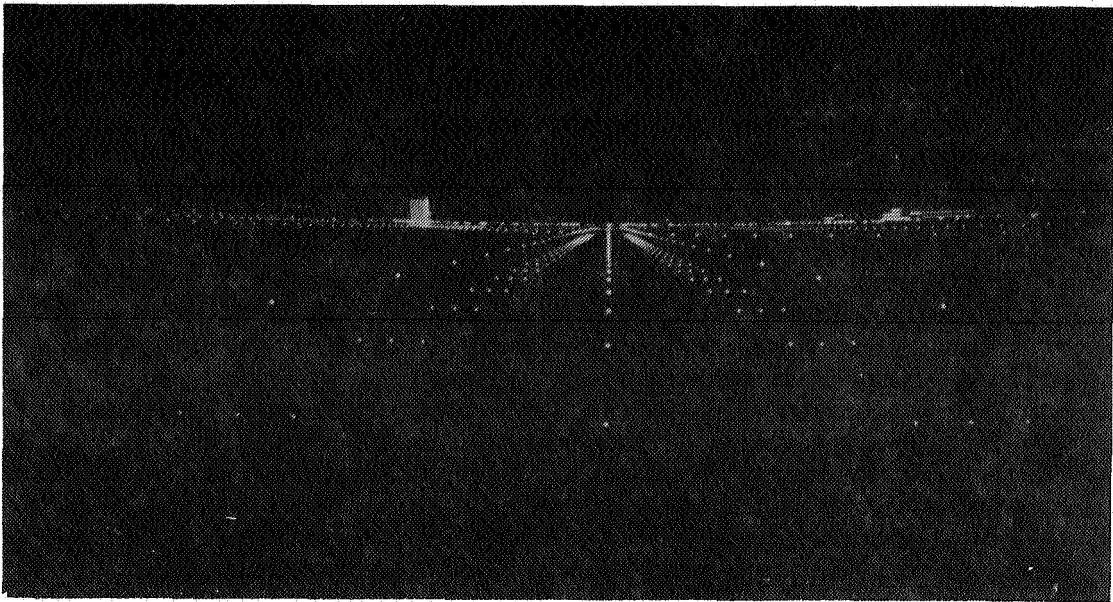


Figure 13.- Night visual scene containing cues important to takeoff and landing practices.

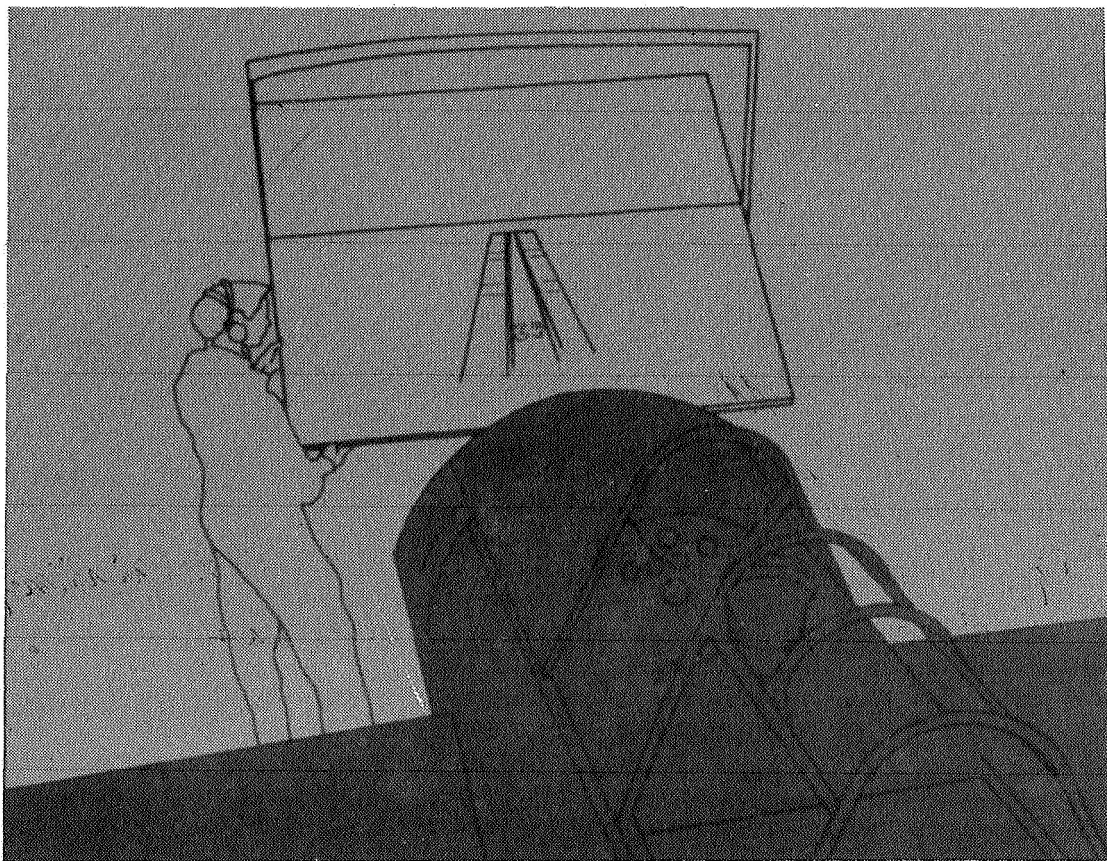


Figure 14.- Visual flight training at the University of Illinois using a run pattern drawn on a blackboard.

and sending pilots to the line who are not adequately trained to deal with any conceivable situation or equipment failure that may arise. In spite of such a tendency, however, important training content can easily be missed. The problem is to assure that each and every pilot has the knowledge about the aircraft he flies, and its many and often complex systems, to enable him to respond appropriately to unexpected equipment failures, environmental factors, traffic conditions, or events involving other crew members or passengers.

Those who are familiar with the Kemmeny Commission report on the accident at Three Mile Island will recall that the Commission was highly critical of the operators of that nuclear power plant because the content of the training provided control room operators was imprecise and was not based upon detailed and systematic analysis of the operators' tasks (Anon., 1979). Available training program development technology had not been employed, the Commission noted. The same criticism probably could be made of a large portion of the flight training conducted throughout the world. Its course content often is based upon tradition and upon the judgments and experiences of a few pilots who happen to be in positions to establish that content. Audit trails between training program content and the training requirements these programs presumably address seldom exist, probably in many instances because the training requirements have been vaguely defined, and the training therefore cannot address those requirements with any precision. Such programs characteristically rely upon stand-up lectures, delivered by instructors who are more or less free to select the course content they judge to be appropriate to the vaguely defined requirements. Additionally, these instructors' expertise is generally limited to the information presented. They usually lack a working knowledge of training technology and of how to make efficient use of the training resources available to them.

Operators who have training programs that have been imprecisely defined and therefore cannot demonstrate the relevance and adequacy of their course content with respect to known training requirements, have two major problems. One is legal, the other is technical. With respect to the legal problem, these operators would be hard pressed to build a defense against a charge that their training is inappropriate, should they ever be required to do so. Since procedures do exist whereby the necessary precision in training program content definition can be obtained, as the Kemmeny Commission noted, it will be difficult to defend the adequacy of a training program that is not derived through those procedures.

The technical problem is possibly even more important

than the legal one. Unless a training program is precisely defined, it cannot be packaged for efficient delivery to pilots, it cannot economically be made available to small groups or to individual pilots when needed, and its content cannot be easily controlled or standardized from one administration to another. The advantages that can be obtained by controlling training through computer managed and administered instruction, advantages that are decreasingly costly because of recent developments in computer and videodisc technology, cannot be realized in imprecisely defined training programs. Further, without clear definition of the training requirements, the adequacy of pilot knowledge and performance at the end of training cannot be measured objectively. Regardless of the good intentions of the instructors and check pilots involved in the training and checking process, it is likely that the evaluations of pilot knowledge and performance will be more a function of the individuals conducting the assessment rather than a function of the performance of the pilots assessed, a situation that has been demonstrated to be the case in training programs where the validity and reliability of nonobjective flight grading systems have been studied (Caro, 1968).

Many training organizations, including several major airlines, have adopted systematic and carefully controlled training program development procedures to deal with the problem of precise training content definition. These procedures help assure that the scope and content of the training pilots receive is sufficient to their needs. Since every hour of training costs money, these procedures also help control training by eliminating training content that is not needed.

The procedures that are employed are varied and have been given a variety of names--Instructional Systems Development, Systems Approach to Training, Specific Behavioral Objectives, to name a few. The things such procedures have in common are detailed and systematic analysis of the tasks for which training is to be provided, and equally detailed and systematic definition of the knowledge and skills necessary to the performance of those tasks. Given the output of these procedures, it is possible to select training resources, prepare instructional lessons, train instructors, and produce pilots with the skills required to perform the jobs given them. Without such procedures to follow, the risks of omitting critical course content or of including unnecessary material in the training programs is much greater.

Just how good are these program definition and development procedures? Frankly, they are very good, but only in the hands of people who are trained specifically to

use them. In such hands, they can produce good training, training that is lean and efficient, with content that is both necessary and sufficient to the performance requirements. In the hands of people whose only expertise is in the subject matter to be trained, however, these procedures are of little help.

United Airlines is an example of a company that has done a very good job of assembling a staff capable of employing these procedures for training program development, and the training programs they have produced over the past decade are generally recognized as excellent. Their programs are lean--there is no fat or nice-to-know information in them. In fact, they are so lean that questions were raised by a number of pilots concerning whether too much had been cut out of the training in order to reduce training costs.

Several years ago, we undertook a study for United to see whether enough information had been included in their pilot training programs. We surveyed about 6,000 United pilots and conducted detailed interviews with about 200 of them. Not a single instance was found in which a United pilot had been unable to perform adequately due to an omission of technical information during training. Clearly, United's program development procedures were working well. United is not unique, however. Many other examples could be given of the success of formal program development procedures in pilot and other training.

Time does not permit a comprehensive review of all aspects of training technology. The intent in this paper is to increase your level of awareness that there is a technology to be applied in training pilots. That technology involves careful attention to the definition of the content of training and to the processes through which it is conducted. Training technology is not a technology of equipment, although there are devices and delivery mechanisms that can contribute to the efficient and controlled conduct of training. When you consider buying equipment, whether it is a simulator, a computer, a videodisc, or whatever, remember that equipment does not solve training problems. In fact, you should not even consider buying training equipment until you know how it will be used, how much, by whom, and precisely for what purpose.

If your situation is such that you elect to purchase training for yourself or your pilots, rather than invest in developing your own, the considerations described in this paper should be addressed to the supplier of that training. How did he establish the training content? How is his training program administered and controlled so that you may

be assured each pilot receives the standardized training you are purchasing? How does he measure the knowledge and performance of the pilots being trained to assure that they have acquired the skills required?

If he does not have very good answers to each of these questions, or is unwilling to share the information with you, don't take a chance. Seek another source, develop your own training, or join forces with other operators to develop training capabilities that will meet your mutual needs.

FOOTNOTES

1. A first-hand account of flight training in the French Foreign Legion, Aviation Section, in 1917, was provided by Charles J. Biddle in letters written to family and friends during his own pilot training. These letters are contained in his book Fighting airman: The way of the eagle. New York: Doubleday, 1968.

2. There were practical advantages of the airplane-like appearance of the Link trainer. In a communication to the writer, Professor Ralph E. Flexman commented: "I remember in my early 'Link training', a single instructor would watch up to four trainees simply by noticing what they were doing via the motion system -- like stalling, spinning, turning, rough movements, etc. -- the wings and tail gave an interpretable perspective for him, and the student knew it, so he tried harder, knowing he couldn't cheat."

3. The costs cited in this paper do not take inflation into account, so the devices pictured in Figures 6 and 8 would probably cost several times as much to build today. The costs are cited only to indicate an order of magnitude of cost for low realism simulators that can be used to provide effective training.

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DISCUSSION

DR. LAUBER: Thank you, Paul. I think that that was a very stimulating presentation that tied together effectively basic concepts in learning and learning theory and practical considerations when it comes to flight crew training.

We'd like to spend some time now entertaining questions or discussion from the audience. Who would like to have the first crack at commenting on Paul's presentation or questions?

MR. COLLIE: I'm Dick Collie with the Regional Airline Association.

Paul, you seemed to skip completely over the motion aspect of simulation. I know we could probably talk about this for the next year, but I would just like your comments on that.

DR. CARO: Motion is probably the most misused and least understood aspect of simulation. Most motion simulators provide with considerable fidelity motion that responds to control input by the pilot. If the pilot moves the wheel, the motion system responds accordingly. But little attention has been paid to providing cues that help the pilot learn to fly or to respond to things that might be going wrong with his aircraft, such as the disturbances that occur when a system fails. In fact, we don't even have good data on cues to provide in motion systems that will enable the pilot to detect motion even that could warn him that something has gone wrong.

We should distinguish between maneuver motion and disturbance motion. Maneuver motion is associated with maneuvering the aircraft and inputs from pilot-initiated changes in heading, altitude, or attitude. Maneuver motion is not of very much value in training because it cannot tell the pilot something he doesn't already know. Thus, it doesn't have much cue value. Disturbances arise from turbulence or from failure of some aircraft component or equipment. Disturbance motion, when it tells the pilot, for example, that an engine has failed, can have critical cue value and therefore can be important in training.

Motion is important in simulation. However, the question is not really whether motion is needed. The question that should be asked is, what motion is needed? Simulation researchers should attend to that question.

DR. LAUBER: Other questions?

MR. SMITH: Ed Smith, Air Kentucky Airlines.

I was wondering how important is it -- you've talked of visual cues even to the point of the man putting the 70% on the N1, this kind of thing. How important are auditory cues? Has that even entered in? Do you have any kind of a sound system to simulate what's going on? Is that important, have you found that out?

DR. CARO: Questions about sound simulation are similar to questions about motion simulation. The question is not whether sound is needed. The appropriate question should be what sounds are needed. What are the sounds that give the information, the cues, to the pilot that he needs to do something, to stop doing something, or to do something differently? If there are engine sounds that alert him to a particular condition that he has to learn to discriminate, then a training device that reproduces those sounds is a good place for him to learn those discriminations.

MR. CROWE: Guy Crowe, Mid Pacific Air.

Paul, you referenced United's concept of training. I think Pan Am does the same type thing. As opposed to our historical method of teaching introductory pilots in the aircraft, we teach basic systems and what goes on under the surfaces down in the bilges, etc., to some degree. It appears that United and Pan Am and some others have eliminated this and reference pilots' training, their needs to fulfill their mission, as strictly to what takes place in their cockpit environment.

I believe you stated in your survey this was a very acceptable training. So you indicate there is relatively little need if proper attention is paid to cockpit duties to not teach systems?

DR. CARO: That's not quite what I meant to say. The detailed analysis effort that is a necessary part of building a training program should identify the systems information that is necessary to effective pilot performance in the aircraft. When the analysis is competently performed, as was the case at United, for example, it usually is found that much less systems information is required than most pilots traditionally have assumed. Learning to perform correctly in the aircraft involves learning specific discriminations and responses, but some system information is also necessary.

When a carefully and appropriately structured analysis is performed by trained educational technologists and expert pilots working as a team, we usually find that much of the information presented in pilot training is not necessary.

Some of that information, it turns out, is not even relevant to the things that pilots do on the line. The question you raised, Guy, is exactly the question that got us into the study for United Airlines. Had too much information about the aircraft systems been eliminated? Based on the feedback we got from the interviews with pilots, necessary information had not been left out. Although some of the pilots we interviewed wanted more systems information in training, they could not point to an instance in which lack of information had interfered with their performance on the line.

DR. LAUBER: Yes. Ed Fell.

Mr. Fell: Paul, my question would be, with regard to the past few years the Agency has encouraged the concept of line-oriented flight training and indeed in the advanced simulation regulation has required that concept to be introduced into the training environment. Your views on line-oriented flight training, number one, had me interested in knowing your views with regard to cockpit specific simulators to be a part of that training; in other words, advanced simulators with regard to line-oriented flight training.

DR. CARO: The line-oriented flight training I've seen I thought was very good. I don't want to endorse all LOFT, because it can be done well or badly. But to conduct training in an operational context is a sound approach. It is an approach that the military has found quite useful in a variety of training situations, not just in aviation. But the content of that training, whether or not it is conducted in a functional or line oriented manner, needs to be defined through a very careful and systematic analysis process.

In terms of whether LOFT should be conducted in an aircraft specific cockpit, I guess that depends on the content of the instruction or the LOFT objectives. LOFT training can be conducted in a generic trainer or even in someone else's aircraft cockpit. The trainer used doesn't have to be precisely configured as your aircraft unless you are trying to teach responses unique to your aircraft. I don't think there is an absolute answer to the question.

MR. FISCHER: Dr. Caro, I'm Bob Fischer from Summit Airlines. Your point that training devices, simulators or whatever, that how they are used is probably more important than the hardware itself, is well taken.

The effectiveness of the training, and the end result of it must be a composite mix of the experience of the individual going into the training, i.e. the level of the hardware available to him and the complexity of the

equipment he is being trained on. How do you go about actually measuring the effectiveness of the training, since it is a variable? Maybe conducting recurrent training in one case, initial training in another case?

Do you have -- are you satisfied with the kind of criteria that you can use to evaluate the effectiveness of that training in addition to the pilot responses, or is there some other way we are not aware of? There is a question in there somewhere.

DR. CARO: There is a whole discussion in there. If you are going to do a competent job of evaluating performance in any field of endeavor, you've got to know what it is you are evaluating. You've got to have a clear description of that performance. Pilot training on the line is difficult to evaluate because it involves such a wide range of skills and responses to such a wide range of cue situations.

Pilots must be evaluated against very specific job related criteria that have been derived through systematic analysis and definition of the training requirements. In fact, the very same analysis proven to be necessary to development of a training program will yield precise criteria against which to evaluate pilot performance. The performance to be evaluated, obviously, is the performance to be evaluated. When a pilot's performance is evaluated on the line, it is really the effectiveness of his training that is being evaluated. Pilots don't fail, but sometimes their training does.

DR. LAUBER: I'm going to cut in at this point. Thank you again, Paul.

I don't mean to cut off discussion, however we do have to stick to some sort of schedule here. What I would encourage you to do -- I have a couple of questions myself that I want to address to Paul, and I know there are others of you who also have the same -- please make a note of them. This afternoon or tomorrow, depending on how the schedule is running, I would like to have an opportunity to come back to these things, because I think they are important issues. And at the very least we can always feed the questions to the working group dealing with the topic that Paul was concerned with. Please note these things and we will attempt to get back to them, but we do have to attempt to maintain some semblance of schedule.

(A recess was taken.)

DR. LAUBER: We'll go ahead and get started. The next presentation follows very nicely the talk that you just

heard by Paul Caro. One of the areas that specifically interested me when I started working with the Commuter and Regional Operators, was the vast difference in resources that are available to the typical commuter and regional operator as opposed to the United Airlines of the world.

In fact, one of the questions that I want to address to Paul Caro at some time has to do with the whole ISD approach to flight crew training and training program development and how that can be accomplished by operators whose resources manpower-wise and otherwise are severely limited. I think that one of the very useful things we can accomplish at this workshop is to come up with some practical recommendations as to how those kind of things can be accomplished.

One of the issues clearly is the question of low cost training aids and devices. Paul spent some time talking about some of those and how those are tied to basic learning of theoretical concepts.

Al Lee is about to make a presentation that continues that discussion and explores some specific systems that have been developed and also looks at the question of technology and the impact of technology and the implications of the incorporation of new technology for training in the future.

Al is a research scientist here at the Ames Research Center. He has been here since January of this year. He is a relative newcomer to our group. Prior to that, he was at the University of Dayton Research Institute where he did Air Force sponsored work on air crew performance and training, human information processing and similar kinds of things.

Al has a PhD in experimental psychology from the University of California. He lists his areas of special interest: artificial intelligence, human operator models, human information processing, pattern recognition and man-machine integration. Al is a member of The Human Factor Society.

LOW-COST TRAINING TECHNOLOGY

Alfred T. Lee

NASA Ames Research Center

You heard earlier from Paul a psychologist's viewpoint of training technology. I'm a psychologist, too, but I have this hardware-software bent to me, so I'm going to talk about, I think, much more practical issues in training technology and just try to concentrate on a very few points.

You're going to hear a great deal in this workshop about technology and air crew training. I'd like to use this opportunity to point out some important differences between training technology on the one hand and the technology of flight simulation on the other. I will also describe two relatively inexpensive training systems in order to demonstrate how low-cost technology when properly applied can meet training needs. Finally, I would like to discuss the potential impact of new cockpit technology on training and, I think, some innovative approaches that are being tried to solve those problems.

In selecting systems or devices to train air crews, it is essential to understand at the outset the differences that exist between training technology and flight simulation technology.

The first distinction I'd like to make has to do with the goals of these two technologies. The goal of flight simulation technology is to design and build a ground base system that duplicates as closely as possible all of the characteristics of a particular aircraft. These include cockpit instrumentation, switches and controls, aircraft handling properties, and the creation of out-of-the-cockpit visual scenes and motion illusions.

The goal of training technology, in contrast, is to provide a tool by which certain specified skills can be developed and maintained. Physical realism or fidelity with the aircraft is only provided to the extent necessary to meet a particular training objective. To provide characteristics of the aircraft which do not support that training objective is to increase the cost of the system for cosmetic rather than training purposes.

The second major difference, which obviously follows from the first, between simulation and training technologies is based upon the perceived relationship between the device

and the aircraft. It wasn't always the case, but it has come to be in recent years that flight simulators are viewed as substitutes for the real aircraft. It is not surprising, therefore, to find that pilot acceptance has come to play a key role in the evaluation of these systems.

A training device, on the other hand, is viewed as a supplement to, and not a substitute for, training and experience in operating the aircraft. It is only used to develop and maintain certain skills which are more effectively or more safely taught on the ground. As with any tool, a training device is evaluated on the basis of how well it accomplishes the purpose for which it was designed. If it is effective in meeting the training objective, it is an effective device.

Finally, training technology is concerned with improving and aiding the process by which air crew skills are learned. Instructional aids and techniques are a part of the training requirements from the outset. With flight simulators, the application of instructional technology is often, at best, an afterthought in the design process.

I've pointed out what I feel are differences between training and flight simulation technology because I think they are too often thought of as one and the same. I don't believe they are. Since the best way of explanation is by way of example, I'll provide two examples of training technology which emphasize the two key elements in training device design. First, provide the physical realism necessary to meet the training objective and, second, provide the instructional technology to facilitate the training process.

The first example of training technology I'm going to show you was developed by the Defense Department to provide alternatives to expensive new flight simulators. With annual simulator costs approaching some 300 million dollars, the need for effective alternatives is clear. One such alternative is the Navy's low-cost training system.

The Navy's goal was to develop procedures and part task trainers which were comparatively inexpensive to buy and maintain but would be just as effective in training both procedural and selected flight tasks. Cost savings of approximately 75 percent were achieved by providing realism only to the extent actually needed.

For example -- and there is a whole list of these, this is only a partial grouping of them -- cockpit configuration is approximate rather than exact. Chairs are used rather than aircraft seats. Photographs were used in lieu of actual panels. Only the most essential instruments are

dynamic. Instrument needle movements are discrete rather than continuous. And redundancies are eliminated such as providing for a single engine malfunction versus all. Flight dynamics are limited to 60 degrees of bank and 45 degrees of pitch. They also included a simplified visual system to permit takeoff, approach and landing training.

The following slides show some of the characteristics of these trainers. And you can see we are down to a bare bone system here. This is the Navy SH3H helicopter. The CRT and keyboard is the instructor station. It swings forward and backward to allow for student self-programmed instruction. It is possible to use this system without any instructor at all.

The second slide is just an internal shot of a twin jet trainer. It shows a fairly good quality reproduction of the instrument systems. A field test was conducted to compare the effectiveness of these low-cost trainers with conventionally designed systems.

Approximately 50 operating procedures and more than a dozen normal and emergency flight tasks were evaluated in the trainers and in the aircraft. The results can be summarized in the words of the investigators who conducted this study. The low-cost trainers allowed training of the same content to the same level of proficiency and with equal efficiency as the more expensive conventionally designed counterpart device. Commercial applications of this approach have been applied to various aircraft such as the DC8, the 727, the 737. Clearly, despite the lower physical realism of these devices, training of the necessary air crew skills can be effectively conducted.

The Navy's low-cost training system is just one example of what can be accomplished when physical realism is provided only to the extent actually needed.

The second example I would like to provide of training technology illustrates the importance of considering instructional aids and devices that are being developed. The sheer complexity of modern aircraft systems and procedures demands a more sophisticated approach to the instructional components of training systems.

This is the interactive cockpit training device which has been developed by Flight Training Devices Incorporated, and it illustrates the wide variety of instructional technology available and how that technology can be effectively integrated into a training device.

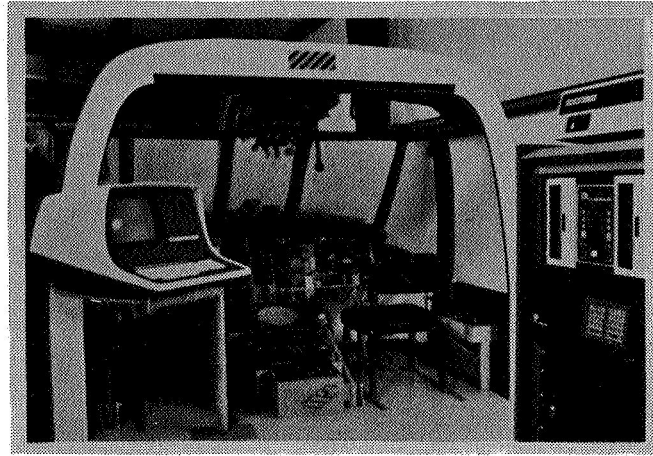


Figure 1.- Low-cost cockpit procedures trainer for the Navy SH-3H helicopter.

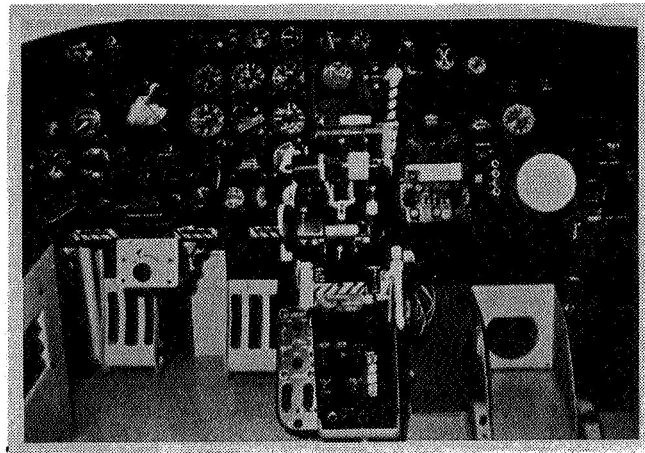


Figure 2.- Low-cost part-task trainer for the Navy EA-3B aircraft.

The system is designed as a total learning environment for systems knowledge and basic procedural skill training. It has the capacity for initial ground school, normal and abnormal procedures training and training in LOFT-oriented crew member duties and responsibilities.

(Figure 3 here)

As shown in this slide, the basic system is composed of a replica of the aircraft cockpit. The instrument panels have been replaced with photographs, and the photographs are covered with touch sensitive membranes. Control lights and dials appear as they normally would in a darkened cockpit. Two projection screens are provided, one on the left, one on the right. One for the pilot and the co-pilot. A CRT screen is mounted between them. These, too, are covered with touch sensitive membranes.

A wide variety of audio-visual devices is included to facilitate the training process. These include random access slide projectors used to show manufacturer's supplied information, computer text and graphics to display instructions to the trainee, and computer generated graphic illustrations, video disks and video tapes to demonstrate real time system operations and procedures, and random access audio to enhance the visual material and provide verbal feedback for training responses. The whole works is driven by an Apple computer which provides programmed learning sequences, controls all the audio visual presentations and monitors and records training performance.

A given training sequence may begin by introducing the trainee to basic system theory such as electrical or hydraulics. Following successful demonstration that the basic knowledge has been acquired, the students might move on to drills in locating and identifying relevant instrument controls and switches.

Normal and abnormal procedures training may follow with the computer taking the trainee through each step on the checklist. The separate duties and responsibilities of each crew member are made explicit and reinforced with audio-visual aids at this point. The training sequence ends with a final exam to make sure that the trainee has acquired the necessary knowledge and skill.

Savings in advanced flight simulator time of 20 to 25 percent have been reported by students trained on this system. Given the high cost of leasing or renting simulator time, to say nothing of the cost of ownership, this type of training technology has a potential for significant cost savings in air crew training. In addition, the system demonstrates the variety and utility of instructional

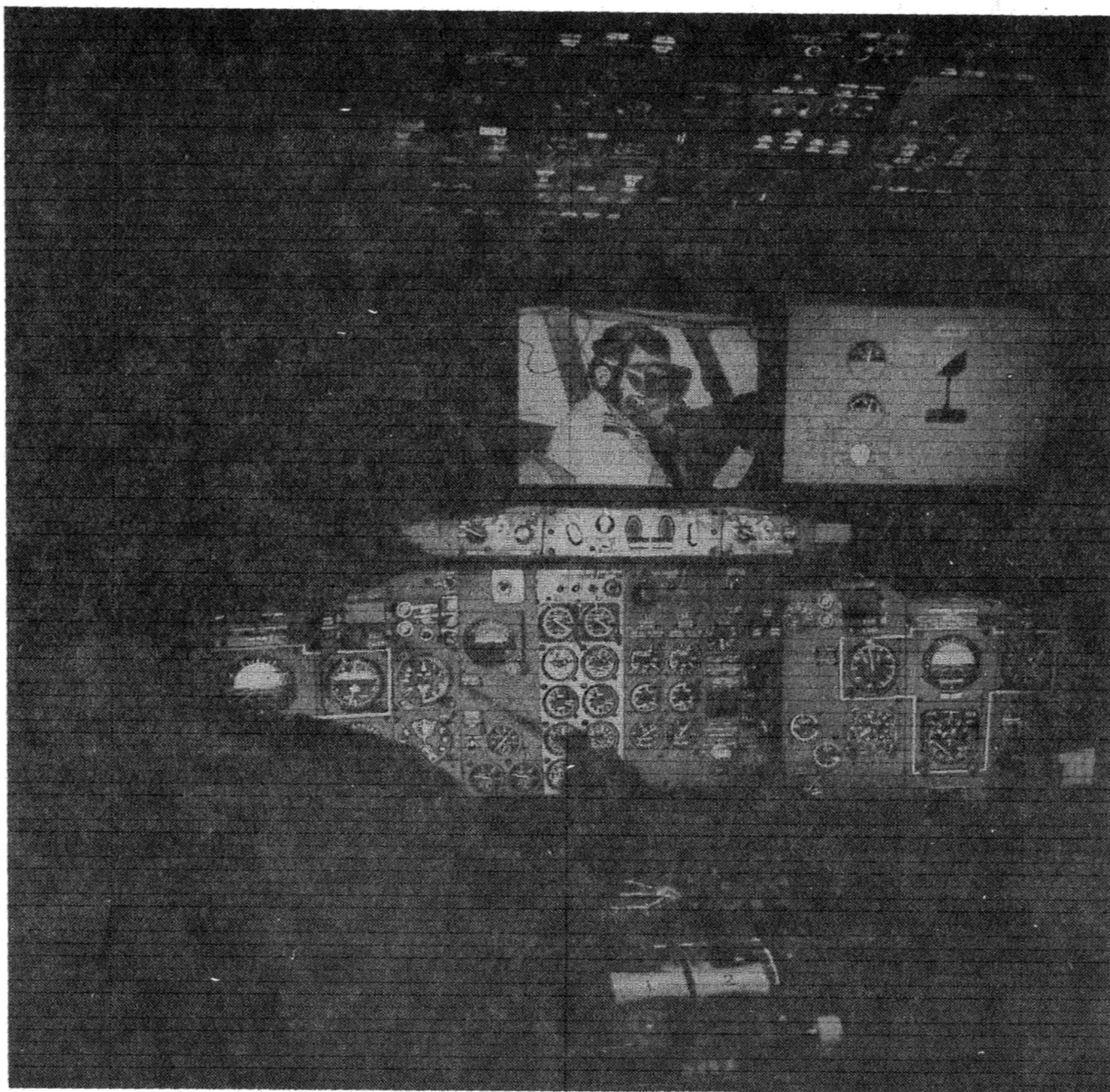


Figure 3.- A total learning environment for systems knowledge and procedural skill training which provides for an integrated instructional technology.

technologies available for training and how they can be integrated into a total training environment.

The two examples that I've just given you highlight the two guiding factors in training technology. First of all, provide only the physical fidelity or realism necessary to meet the training objective and, two, provide the instructional support to insure the most effective use of the training device.

Up to this point I have described devices which have been effective in training for today's aircraft technology. I would like to take the remaining time to discuss some training problems that will probably arise in your operations in the not too distant future.

I'm sure that all of you are aware of the fact that aircraft cockpit instrumentation and control systems are undergoing a gradual but inevitable change. Microprocessor technology and high resolution graphic displays are being introduced into the cockpit with increasing frequency. The following series of slides illustrates this trend.

(Figures unavailable for publication)

This is an inside shot of a Boeing 747 conventional cockpit. And this is a Boeing 767. We are seeing the initial introduction of CRT displays. The next is the FA-18 Navy fighter and you'll see how the explosion in microprocessor technology has found its way into the cockpit. There are a variety of multifunction integrated displays on this system as well as the head-up display, and the sidearm control fly-by-wire system.

And last, NASA's own advanced cockpit here at Ames Research Center which was designed by Lockheed Georgia. And you see some of the things I'm addressing here that are inevitably going to find their way into the cockpit of the future. You see a whole variety of multifunction flat panel displays in the cockpit, a lot of keyboard entry, head-up displays mounted on the wind screen and the sidearm controller. The amount and variety of information that a pilot will have access to in the cockpit will increase rapidly in the next decade. There is no doubt about that.

Multifunction integrated displays will replace conventional flight and engine instrumentation. They will also be capable of displaying fuel, electrical and hydraulic system status, digital images of charts and maps and even the relative position of other aircraft operating in the vicinity. Only a small number of CRT or flat panel displays will be provided. Each will serve many functions.

For the seasoned pilot accustomed to scanning conventional instrument displays, extracting the right information when it is needed from these systems may require extensive training. Some of these systems have a dozen or more display modes, each mode having several different display configurations.

Furthermore, these systems will be providing a quantity of new information and symbology which older conventional aircraft do not provide. Interpreting and using that new information effectively creates a unique training problem. Those that make extensive use of this technology now, the military service, are already discovering that training pilots to use this technology is not a simple matter. Substantial simulator and aircraft training may be required to familiarize pilots with operations of these new systems.

Since the cost of such training is obviously very high, some innovative techniques are being tried. One way of training pilots to operate this new cockpit technology, specifically multifunction displays, is through the use of special function trainers.

The trainers are composed of small desktop computers coupled with high resolution color graphic displays. The displays can provide the same information available in the aircraft with the same level of detail. The pilot can operate the system through light pens, keyboards or touch sensitive membranes.

(Figure 4 here)

Two examples of the many systems that are currently being developed are shown on the following slides. This is a special function trainer that is designed to train for the head-up display, the weapon and stores control panels for the new Northrop F-20 fighter.

(Figure 5 here)

The next slide shows another example of the utility of special function trainers for use in training CDU operations in 757/767 aircraft. They are easily transported to wherever the aircraft is based. They are highly flexible since only software changes are required to create new display system. Most of all, they are effective in supplying the training needed.

I began this talk by noting some fundamental differences between training technology and simulation technology, and I provided some examples of low-cost training technology that have been effective in lessening the cost of air crew training. I also showed how the same

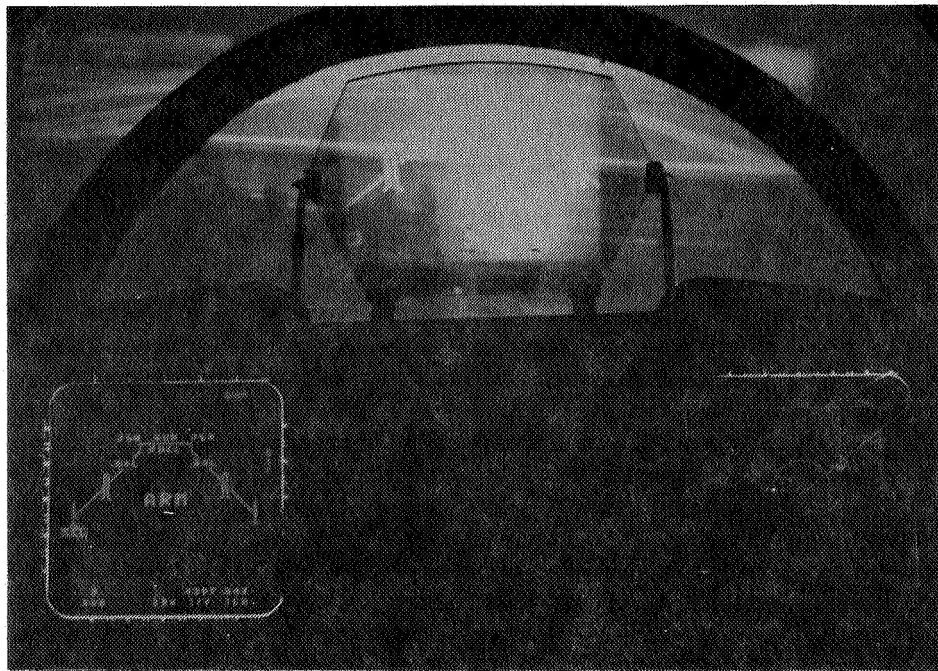


Figure 4.- Head-up-display trainer for Northrup F-20 fighter.

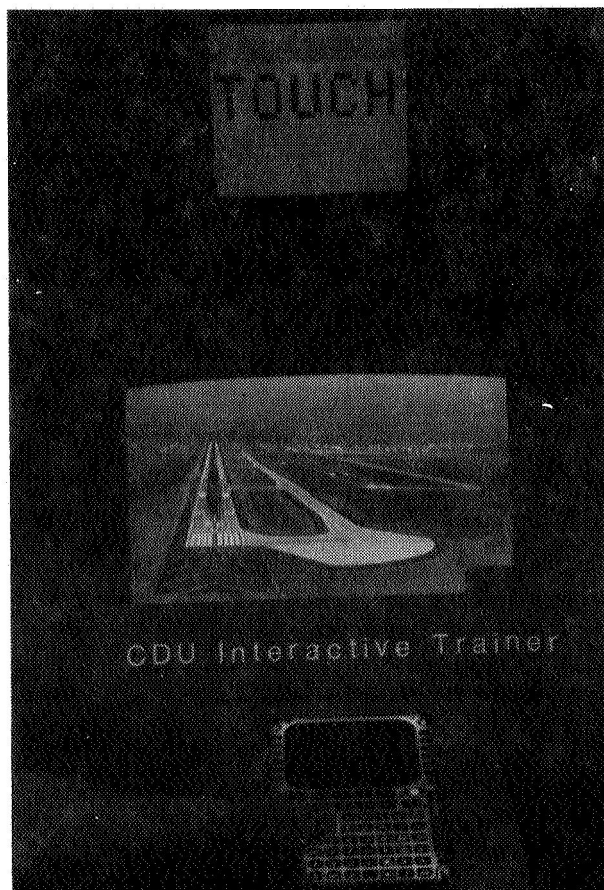


Figure 5.- CDU interactive trainer for 757/767 aircraft.

computer technology that is entering the aircraft cockpit can play a major role in training pilots in the future.

It is important to keep in mind, however, that technological innovations should not dictate what kind of training program you develop. Define the training objective first and then decide on what training system is needed.

DISCUSSION

DR. LAUBER: Thank you, Al. A very interesting discussion. Again, I have a couple of questions.

One question that I have has to do with the technology issue. By incorporating microprocessors in the cockpit of the new generation of aircraft, it seems that you are also providing the potential for the inclusion of training modes as well as operational modes in these devices.

Do you know what, if anything, has been done with some of the military systems that you talked about? Do they include training modes in the onboard avionic systems of some of the advanced aircraft?

DR. LEE: Let me state a kind of philosophy about these new systems that I think that most of you probably share. It's been my experience in dealing with military pilots that the folks in the software department have gone a bit beyond the call of duty in designing some of these systems. I found that many pilots spend a great deal of time trying to figure out just exactly what this thing is supposed to do. We have a very powerful technology here, but it doesn't seem that either in the design or in the conceptual stage we've really considered what the pilot has to do to deal with that information.

So to answer your questions, there is no specific training mode included. As far as I can tell at this state, it is all a training mode. The pilots will frequently go through as many of these displays modes as they can in the shortest time possible and try to figure out what they are looking for. So right now I think the technology that is being introduced into the cockpit has not dealt with the human factors issue very well at all.

MR. BEUTLER: I'm Grant Beutler from Seville Training Systems. Would you talk just a bit about the self teaching capability of that computer that was behind that one kind of device, what kind of instructions were given and what the results have been with it?

DR. LEE: Which device?

MR. BEUTLER: The one that had a terminal on the left side there.

DR. LEE: Okay, the Navy's training system. Basically, the CRT is manually driven, so it will provide the student with the manual select maneuvers or procedures that they would like to practice. And the student will simply select one, and following that the system will generate in text form what switches and dials have to be repositioned to set up for that particular maneuver. Once the start button is "pushed" it goes to that sequence.

Now, that particular system is designed only to provide -- and this goes back to Paul Caro's discussion -- some of the onset cues for malfunctions that occur. It does not give a progressive degradation of malfunctions that would occur if the student did nothing.

So the key, I think, in that system and in systems like it is to provide the kind of onset information that you'd like the pilot to condition his response to at the outset rather than trying to turn all the possible degradations that the system could go through before the malfunction was corrected.

MR. FELL: The question would be: You showed a couple of trainers that were Navy trainers. One had, I believe, a heads up display, part task trainer, and another weather radar. My question is: Are those separate trainers and are they teaching just part task training for each individual system in the Navy? And if so, is the assumption that when they are thrown into the aircraft or full motion simulator that they are going to be able to assimilate all that knowledge that they have gained into one overall full mission type trainer? Or how do they assimilate all that knowledge into one final piece of information to analyze the pilot's abilities?

DR. LEE: At this point I think the technology is so far ahead of our concept of trained people, that is not a particularly easy question to answer. What has happened, I think, is that systems have been retrofitted in some cases, in some aircraft cockpits, and in other cases they have been put in without too much concern with integrating their information into other systems that are already available. So I think what's been done has been often a very quick fix to a problem that I think is growing very rapidly, particularly in the military services, so that these systems are in fact just part task, and the finishing touches, so to speak, the integration of skill occurs later on more advanced systems or in the aircraft itself.

DR. LAUBER: We have one more in the back of the room.

MR. DALY: Paul Daly, Embry-Riddle University. I'm a little confused as to what lesson you're trying to teach me. I got the impression that you were providing part task trainers like the one for the SH3H, and yet in answering questions you seem to be presenting the idea that maybe part task training is not a feasible approach. What exactly are you driving at? First of all you downgraded them into the part task training and then you cast them into a system statement or something.

DR. LEE: I'm not sure if I understand your question. But my intention is not to downgrade part task trainers or the concept. I simply provided those systems as a demonstration of how in some cases you can eliminate some physical realism and not suffer an impact on training effectiveness as a result.

MR. DALY: Well, I would agree. What are you saying is you can use part task trainers effectively and not only training effectively but cost effectively?

DR. LEE: Yes.

DR. LAUBER: Okay. Thank you again, Al.

Again, I hate to cut off discussion, but we will have plenty of opportunity to come back either later today or tomorrow or during the individual working group meetings to address specific questions to Al or the others who are speaking here.

We are going to switch themes at this point. What we've been talking about so far this morning is training technology, simulation technology, training aids and devices. And most of that discussion has been oriented toward the technical skills aspect of training.

All of us in this room are aware that training the technical skills required to fly an airplane is only part of the problem. We've come to recognize that there are far more complex skills involved in operating a modern airplane including what we call cockpit resource management and related kinds of issues; things having to do with leadership and the development of command authority, communication on the flight deck and similar things that several of us here at NASA have an abiding interest in.

So the next several presentations are actually going to deal with various approaches to this kind of training taken by several airlines to again get you thinking about some of the issues and some of the approaches that have been taken,

the relationship between the weather display and the outside or external scene from the cockpit. And the keyboard allows, say, putting in different course changes and what not. So it's really a rather artifactual view, but it takes the point that both Paul and I make that we're really trying to train a particular kind of cognitive skill here, and it's not always necessary to have things in the exact configuration they are on the aircraft.

CAPT. SIFFORD: It's a stand-alone system; is that correct?

DR. LEE: Yes.

DR. LAUBER: Two more questions. Go ahead. Back here.

A VOICE: You mentioned a study that showed the benefits of low cost simulation versus high cost simulation, but you didn't mention what that study was. I'd be interested in knowing what the study was and what type of pilot groups were involved in that study.

DR. LEE: I can give you a copy of the article, but, as I recall, they were initial qualifying trainees into the -- two aircraft were essentially tested. The SH3H helicopter was compared to a fixed base operational flight trainer with a visual system but no motion. And the comparison was the rate of acquisition of skill on both systems and the performance in the aircraft at the end of it. Basically the differences are not statistically significant. I think there is probably a half an hour difference.

A VOICE: With regard to the high cost simulator, could you tell me would you have any knowledge of what criteria were used to evaluate that device and the low cost device? Were there any hardcore criteria that either one was evaluated against?

DR. LEE: You mean as far as pilot performance is concerned?

A VOICE: As far as the device itself in matching aircraft performance.

DR. LEE: No, I don't think there was that kind of systematic comparison of every possible specification. What I think the Navy did was say what can we get away with here, what can we do with the least, and went from that point. I don't think there was any kind of broad technological framework to this. I think it was a trial and error process that they went through.

MR. FELL: Based on your knowledge and experience, would you say that that perhaps is a good learning approach, or based on their experience and your experience in observing them, has that worked? Or do you think the Navy or any armed services or any commercial carriers should go more toward analyzing the pilot's ability in a full mission simulator prior to sending him to the line? Or do you think the part task trainers are adequate in assuring the pilot's capabilities?

DR. LEE: I think that some integration is necessary along the way. These systems have become so dominant in the cockpit that it just takes so much time in simulation or in the aircraft that you are really forced by circumstances to take a part task approach.

Now, from what I can tell, and there is some data to support this, the pilots do have a much easier time of integrating this new display technology, this new information, into all of the other information they have in the cockpit provided they are given some part task training at the outset. If not, not only their responses to a particular system like the heads-up display degrades but sometimes it overflows into other behavior as well.

CAPT. SIFFORD: Jim Sifford with Piedmont. In the trainer that you showed us, it appeared that that radar screen was above that of a windshield of a simulator, or was that in a real airplane? That's the first question. Second, approximate cost? And third, this is for teaching peripheral systems for the airplane such as performance management system in a generic sense as well as heads up display or automatic recording systems such as a peripheral system in general. Is this the intent of this?

DR. LEE: Of the weather radar system?

CAPT. SIFFORD: Of the trainer as you had it depicted there.

DR. LEE: That is a part task system that's fixed base, and I don't have the precise figures on it offhand. It's still under a prototype contract development. I'm not sure exactly if I have your question right, but as far as the weather radar is concerned, that's an integrated part of the system.

CAPT. SIFFORD: On your display on the slide, it appeared it was mounted over a windshield or something of that type.

DR. LEE: The reason for that was that in this particular system there is some training going on that shows

with the idea in mind when we get into our discussions with the individual working groups tomorrow, you will make use of this material to come up with sound, substantive recommendations that can be applied to your own specific operations.

The next two speakers are from USAir. Captain Stan Fickes is a flight operations manager on the 737 airplane. He was employed by USAir when it was still Allegheny. And in 1967 was named check airman and flight instructor and has approximately 16,000 flight hours. Stan was the individual -- we've worked with Stan before -- who was responsible for the introduction of cockpit resource management at USAir and is also concerned with the introduction and new aircraft procurement programs and the development of training programs for those new aircraft.

Dr. Bob Sellards is a PhD. His degree is in clinical psychology from the University of Pittsburgh. He teaches at the University of Pittsburgh Medical School, the University of West Virginia and Indiana University medical schools and also works as a consultant to several professional football teams. I'm going to be interested to see if Bob really ties that into his presentation this morning.

Bob flew medical evacuation helicopters in Vietnam, and has been working with pilots since Vietnam, with USAir for the past four years looking at various human factors issues including, he mentions, the issue of subtle pilot incapacitation and how to deal with that in training programs and the relationship of that to incidents and accidents.

So with that, I'd like to introduce the two gentlemen from USAir.

CAPTAIN DEVELOPMENT TRAINING AT US AIR

Stan Fickes, USAir

CAPT. FICKES: Well, I'm Doc's front man, so I go first. I'm really pleased that our cardboard trainers that we use at USAir are still in vogue. We use them a great deal, and they are very effective.

It's been an interesting morning. The entire agenda that John and Dick and their associates have put together is going to be of interest to all of you. I am proud to be here. I am pleased to be involved with your program.

And by the way, this is the commercial portion of it. USAir, as many of you are aware, has a very strong association with your organization. We date back to 1967 with Association of Commuter Airlines. There are now 12 in our group, and we strongly support your activities. End of commercial.

It was about four years ago that I was seated in the audience of a very similar seminar on resource management up in San Francisco, frantically taking notes and wondering how in the hell am I ever going to develop something that will be effective for our pilots, our macho pilots that eat training programs. They subsist on training programs.

So, really what I think the next couple of presentations will deal with is methodology, and that's really the secret. We all know what we want to do. It's how you do it. And I think once you determine that you'll go home and you'll do something, and it will be effective. Believe me, whatever you do is effective. Once you do the program, then John calls you up and invites you to come out here and present your brand of magic.

So without further ado, I'll really get into the meat of our full presentation. It's broken down into two parts. First, I'll provide a brief overview and background of our training program, and then Doc Sellards -- as I say, I'm really his front man -- will really get into program activities, the curriculum and tell you some of our experiences in the past four years.

Late in the 70's, USAir began to enjoy a return of growth and expansion which had stagnated for several years due to the energy and economic conditions. When it became

apparent USAir would begin a long range upgrade training program for captains, management recognized an opportunity to introduce specialized training in leadership, stress management, interpersonal skills and subordinate assertiveness.

Our industry was aware of the air carrier accidents revealing a principal factor to be the lack of effective flight deck management of available resources by the flight crew members. The industry had experienced numerous accidents in which the crew concept had failed because of lack of coordinated effort and crew member lack of communications of their observations.

Following the 1979 NASA industry workshop, Resource Management on the Flight Deck, we felt enough information was available to develop an effective training program. Our customer services department had several training programs, which I reviewed along with several proposals from outside consultants. Also during this time, I had discussion with our ALPA Training Committee to keep them informed of progress and to get their inputs.

Union support of and participation in any important element acceptance of innovative training is very necessary. You have to get the union behind you, if they are a factor in your particular operation.

We launched our first program for review by a committee of 16 supervisory pilots and our ALPA training committee using a consultant who had modified a customer contact proposal. Well, unfortunately it sank very quickly into a sea of criticism. The proposal was very general. It was designed, as I say, for customer contact, a lot of philosophical approaches and not, what we would call back in Pennsylvania, meat and potatoes. Pilots are technically oriented, highly instrumented, and you just cannot feed them a lot of philosophy.

About that time, I met Dr. Sellards through contact with the local university, and we had some rather lengthy discussions on what we were trying to do, the objectives. He reviewed all of the material that was available at that time, and there is lots of it out there. Material from workshop, from IATA, flight safety, FAA and accident reviews.

It was interesting to note that Doc immediately drew a parallel between pilots and physicians. His background included teaching medical students to deal with the God-like role they are forced to play under stress situations.

After we had gone through the study and determined what

we wanted to do, I then arranged for Doc to spend several days out on the line flying in the normal line environment. I might tell you I was particularly happy his first morning when he arrived at the airport -- and this was not by design; it was just by circumstance -- there was a cold front going through. So he pounded through that cold front three times in one day, ended up in Providence rather than Newark, got up the next morning at 5 o'clock and ferried the airplane down to Newark to begin their day's activities, and had a first-hand view of what flying operations are like. Not a lot of theory but a lot of practice.

Well, following this period of orientation for Doc, in which it was not only the line operation but simulator and ground school and so forth, we developed our initial program which was designed for supervisory pilots. We determined that it was important that we start with the supervisory pilots, give them a course that would deal specifically with their role as instructors. And we gained a lot of experience and feedback information from that particular program. It is a requirement that all supervisory and check engineers go through this particular course.

Our next phase was to introduce a three-day training course for student captains. We felt that that was prime ground to begin our training, to introduce it. We got a salty old captain that has 30 years; that's "old Joe," quote, unquote. He's been doing it well for 30 years, and it's going to be very difficult to win him over, certainly in an initial program. So we felt that we were right to work with the student captains.

Our first day consists of a brief review of technical subjects, and we use a couple of buzz words here, technical and nontechnical training for our students. We deal with the flight ops manual, op specs, FARs, weather minima, that sort of thing. Then we have visitations from key personnel in the various departments; i.e., our air traffic factors, maintenance, systems control, customer services, station personnel, to really present an overview of their functions, the interaction and the relationship and where the breakdown of the system occurs between flight crew members and the particular department.

We also include with that first day's presentation a considerable amount of handout material. We've developed a handbook; it's called "The Captain's Handbook." It deals with a lot of information that he will find useful during training procedures, et cetera, et cetera. Doc has developed a handout that is a fairly lengthy book entitled "Behavioral Sciences for Flight Crew Members." We have self analysis testing in there, and I'm not going to really get into that too deep because I think Doc will, but that type of information is contained in the handbook along with

testing and information on weather minima.

Really, the first day material is a review, and it is designed to give him information to get back home and do a home study course.

The second day begins with a presentation by one of our senior supervisory captains on various management styles, and it includes a managerial grid which he has designed for captains. He then discusses several accidents which we believe involved goal oriented versus group oriented captains. This presentation serves as an introduction into Dr. Sellards's lecture on leadership and resource management.

The third day, the director of flight training opens our session with a presentation on safety and an audio-visual review of several air carrier accidents. He attempts to project the class into scenarios in order to develop and foster a discussion of their views on crew concept and interaction. This is well received and generates a wonderful learning process for the group. It also serves as an excellent introduction into Dr. Sellards's second presentation.

That's a brief overview of our captain development training. We feel that it is a very effective program. Partially it's gauged by the student response. Hopefully, it will prevent accidents. As I say, we believe it is an effective program. It reinforces our flight training where we stress the importance of crew concept. To date approximately 350 captains or a little more than one-third of our captain roster has completed this training.

I'd like to conclude with just a few brief observations which I made during our program that may be of benefit to you. The first one is that strong support for nontechnical training must exist at all levels of management as well as union support. The second is that flight crew members may have difficulty understanding the application of nontechnical training into their cockpit environment. However, they do have a very strong interest in behavioral science which can be applied to the domestic situation. Students quickly identify where training would be of merit in their personal lives; i.e., in many cases they may have children at this point that are in their late teens or a girlfriend that is giving them a problem or a wife or whatever, but they do very quickly leap over into the cockpit situation.

Another point is that supervisory personnel should receive additional specialized training that deals with their role as instructor and their interaction during training.

Training should be conducted in a nonthreatening environment. This is very, very important. For example, the self-assessment type of test must be just that. You've got to use a nonthreatening format, let the student do his own testing, look at his own results.

Another point is that you should not evaluate student action or develop profiles of individuals during this type of classroom training. At the end of our program, we use an anonymous type of assessment form for the students to evaluate the effect of the training, their particular recommendations and so forth. We feel that that is also very valuable information.

That's about all I really would like to say at this point. I think we'll let Doc come down and do his presentation, and then we will entertain questions.

DR. SELLARDS: Basically the reason that we have put the program in was to try to cut down on loss of life because of the high correlation between the human factor, pilot error (whatever that means) and accidents. That's our bottom line. That's what our goal is. We're doing some research which I can get to later.

As Stan mentioned, originally we ask for an anonymous questionnaire at the end of the period, and then we go out later and ask for questionnaires down the pike. Right now we are very pleased with what we are getting.

As I go through now, I'm going to draw some key points that I've found over the last 15 years in working with pilots from Vietnam and up until now. With that I'll go ahead and get some slides to show you here.

I want to show you that we did do some research looking up ex-pilots to basically get some history of pilots. And this is one guy we talked to. The other problem we found with pilots is sometimes the self-image -- well, first of all, this is another ex-pilot we found who was over in Vietnam. He had retired over there and moved on in a better field.

The other thing we find, the image of a pilot sometimes is important because pilots tend to view themselves one way sometimes, and then the problem is as viewed by the rest of the people, and that sometimes leads to a problem which we call cognitive dissonance. So we try to address those kind of issues and look at them. So we have this problem with pilots, as I say, the self-image, or the image they project and how other people see them.

Another thing that comes up periodically is how difficult it is to teach pilots human factors. I did all this to draw a visual cue in the past, because sometimes it's very difficult to get pilots to look at the human factor. I think this is one of the problems that plays into the total training program that is very difficult.

Part of what I think is the key to training is that in the human factor we are really talking about education, not training. That means that you have to bring the pilots into a situation; it's a classroom situation. I consider that to be line-oriented training. It's not done in a simulator, and I don't think it has to be done in a simulator. The leap will be made from classroom to real life. Everybody makes leaps every day in their lives. So we try to arrange the program so that the beginning of it is not a compulsory situation.

One of the things we are looking at is that when you

look at the human factor, the professional flying skill -- now we are talking about a large percentage, whatever percentage you want to put that at, whether it's 50 percent, 25, 90 percent of the accidents you have, this professional flying skill plays only a partial part of it, and the big part is the human factor.

And that's what we are talking about here. We are talking about educating pilots to look at the human factor in the cockpit; two people not talking together, nobody flying the plane, it could go on and on. It's very hard to see the pilot error, and no one can really identify it, because people are not trained or educated in that way. So that's kind of my message of what I've seen over the years.

The other thing has to do with the self-deception, if you want to go back to the way you see yourself and the way others see you. What we find in the class a lot of times, one guy calls the captain an SOB maybe, it isn't as effective as if 20 people call him that. So he kind of gets the idea, and the bell starts to ring, that maybe the way his style in the cockpit, he starts to say, hey, maybe I should look at that. That goes on periodically in the classroom, this idea of self-deception.

There was an article that came out about one flight, which I'm sure you've seen. Now this pointed out that if you have a pilot that hopefully has not participated in a crash but let's say has marriage problems, investment, business, everything is going down the tube, then the hypothesis is this pilot may have a problem in the cockpit, because you don't just leave it here when you enter the cockpit. And that's the human factor. So we try to address some of those issues, which that article did, by the way.

The other thing is pilots are very technically trained. The equivalent would be how you work with physicians when you train physicians. They are technically oriented people. They want to get a technical answer and there sometimes isn't one. I think that's the key point. In working with people you don't always have a cookbook that you can work with. When I'm working with my eight-year-old boy, I can't always pick up the book and say, okay, he did this today, then the manual says I do this with him, because that's not the way my 8 year old tracks; and my wife doesn't track that way either. Consequently it leads me to have a problem sometimes, and those are the issues that we are talking about in the program.

And when you look at the brain, you can look at the right-left brain situation. Are pilots that way because they selected that occupation? If you want to look at the physiology, then you can look at issues of right and left

brain concepts. There is a lot of stuff written on that. So we get involved with some of those kinds of things. So the physical aspect may play a part in one human factor in accidents.

Some of the things that we found about pilots is -- and this is nothing new; you know about this -- it is the most checked profession of any. There is no profession that is checked like pilots are checked. Like for example, if I go to a medical convention or something, I can just sign in and play golf for three days as long as I register, whereas that's not the case with pilots. These are issues that we found that play a key part in a program.

Like number 6 on the slide, we find that pilots spend time, you know, strange beds, strange people sometimes in those beds, food, those kind of issues. The circadian issue thing, the whole thing with the clock being upset when you are flying, that kind of issue. It doesn't necessarily mean there has to be a three-hour time zone change. A lot of these problems stay hidden. And that's what we try to bring out, that people have problems and what you are experiencing as a pilot's are no different from somebody else's problems. But it has never been looked at in the education of pilots, the same way it's never been looked at in the education of physicians until the last few years.

And then you have the whole change in medicine in that we are changing over to more family practice. That's what you see, 80 percent of the people coming out of med school are in family practice.

It also takes a special kind of wife to adjust to a pilot. You have to have a special kind of a person when a guy comes off a four day trip not to say let's go out to eat, because that can be very trying sometimes, and of course jet flying overall is stressful.

Also here again, and this I think we touched on, but the whole mechanical reaction type of situation, and I've already kind of drawn this point out, but I want to reinforce the fact that you have to get away from this. It's very difficult, at least in what I've experienced, to train physicians and/or pilots in a simulator to handle human factors. There has to be a prior step before stepping into the simulator to talk about things like the human factor. You can't start in that type of environment. No educational process does that, so you can't do it in aviation. You don't start out saying, okay, Doc, we're going to put you in the operating room; you start doing open heart surgery and as you are working through it we're going to look at what your variables are as to how you are operating in that operating room. You have to go through an

educational process before they step into the cockpit.

As I said right here you're seeing a whole shift to family practice, and there has been a shift in medicine back to the total person. We've gone from the general practitioner all the way around now to the family practice where 80 percent of your med school graduates are coming out with that training, because you have to look at the total person. And so consequently you've seen that whole shift. And aviation is going through that process and has been for the last few years.

You have to believe in the training. We will have pilots come out of the program and over a beer they will say well, I'm not really sure, yet on our assessment form they rate the program high. So there is a variable of playing a certain role. So some of these issues are key issues that they feel very strongly about. However, here again in the peer situation they don't always verbalize that. They'll say, well, I don't really know about transactional analysis, I don't know about that. And yet when you talk to them two years later they'll say, hey, Doc, I've been acting like a kid too much in the cockpit. I guess I've got to look at that behavior, or something like that. So that's what you are looking for, that subtle kind of a change.

The whole emphasis in pilot training has kind of been A-B-C-D. And when you get a stress situation, and this is a human factor, it doesn't track that way. So you have to educate people to look at both ways of handling situations. The fact that you are in this profession to fly because you enjoy A-B-C-D thinking; or is it the fact that neurologically your brain functions a certain way and then you get back to the left-right brain controversy or discussion. So whether you look at it from a nature or nurture argument, the fact is you are trained a certain way and you have to look at the way pilots are trained.

And the other thing you have to introduce is the A-B-X-Z-C, thinking process. And as I say, that's the way my eight year old tracks sometimes, and my wife tracks that way sometimes too. So I have to stop and look it over, because there is in fact no cookbook to handle that way of thinking. So that's a key issue that needs to be addressed.

Here again people tend to operate with blinders. That's a known thing. I thought of this today. I looked at everybody who goes downstairs here. And I just wondered, if we went up to the top exit, is there a restroom up that way also, for example? But everybody tracks a certain way under stress. That's why we see in a fire if everybody goes a certain way then you have a situation where people are trampled and die. It's not, quote, normal behavior, and

those are the kind of issues that need to be discussed in our program or any program.

People sometimes look at behavioral science as too complex. So what I try to do in a program is to help people understand it is not a complex issue. There are many issues that need to be brought out. For example, the difference between Freudian psychoanalysis and behavior modification, is not a difficult concept, but if you've never addressed it in your life it's going to be difficult. And so consequently one part of our program addresses those different theories/concepts and I think any program you institute should address those type of things so it gets away from the fact that it's not really something one can deal with.

The other thing is, that I think Dr. Bolman will touch on this -- about the theory of practice and the theory of the situation -- and those are issues that we need to talk about. There are other key issues that have to do with and the expressivity and the instrumentality type of thinking. You have to get a person to relook, rethink, redo, and that's in essence what we're talking about in our program. That under stress -- the things mentioned previously are the things that we found people saying causes them to have a problem when in the cockpit. And even we've had some pilots that have come through the program that have been victims of crashes, and we let them explain their situation, what happened and would they have done it differently. These are the kind of negative things we are trying to avoid in future stress situations.

Number 7 in this slide is a big one for people who have flown in the right seat for ten, fifteen years with USAir before they can make the leap over to captain. They are not really listening. It's like -- I'm on board now, pull up the ladder, once you make captain. And those kind of issues we have to address and have people go through a thought process in two days, which is kind of pushing it, so they can begin to accept some of these issues. As presented on the slide.

The program possibilities are things that I've already mentioned. What we do is at the end of one day they get a series of self-assessment tests. They take the test and other tests which have to do with their leadership style, and they have to do with things like the frustration, overload, deprivational stress; those kind of issues that play a key part in their life. And the fact that if they are having problems at home, usually pilots take that into the cockpit. There have been a lot of studies which show this, and we talk about those kind of issues and how that ties in, the whole mind-body tie in, the psychosomatic, and

also developmental patterns so they understand how people develop, and that there is not a big mystery once you get to discuss those kinds of issues.

And basically it's an educational process. It's teaching basic stuff the same thing happens in medicine, the physician has never had a chance to look at those things, and consequently in these two days we try to look at these issues so that pilots can then say, yeah, I agree with that, so when they get into the cockpit they are going to stop and think and not set up a situation like Tenerife, where you have a parent to child type communication, and the guy in the right seat cannot question what's going on, and you get five or six hundred people dead because of that. You can go on and on in different accidents that have occurred with similar scenarios.

Here in this slide we look at some of the studies that are being done. Our pilots are trying to assess their own stress level, and there have been different studies that have been done that show for example in interviews with 148 crew members and their wives in this situation trying to find out -- that what's going on at home does affect the cockpit.

So basically that's the end of my slide show. Another key thing I would say is that there is another variable, that technical versus nontechnical.

The nontechnical is the behavioral science aspect. The other thing is we want people to internalize it, because the theory is, I believe, pilots are externally driven. They rely on the manual. They rely on the simulator. We don't want them to do that in a stress situation, because that isn't going to be a positive payoff for them. And you can't, here again, look at a cookbook.

I want to make the point, that we rely on the pilots to make these educational leaps, because here again you make leaps every day from something you read in a book or something you see on TV. And you say, okay, I understand how that can apply at home. We want the same leap to be taken, because if you spoon feed people they don't tend to want to make many leaps from theory to practice.

We are trying to make the pilot struggle. Sometimes they reject it at first. We don't get the rejection on the assessment form, but we get the objection in a classroom sometimes or over a beer at a party, because they just don't want to change or show change too fast -- this guy has been a captain for fifteen years, and he is viewed as a real hardass, and he doesn't want anybody to know that he really isn't. And so consequently a lot of times that won't be up

front, but it will be on our assessment forms. And that's where we feel that we are making movement -- we have not had any negatives so far. We have had some people that waffle on, I think, a five point scale who are at four point six, or something like that. But that really isn't the key. We know we are doing some good from the feedback we get.

So those transferences and the cues we are talking about -- it was brought up earlier -- the cues are the leadership scores, the test scores and we want those to be cues. So if you are looking at the Holmes and Rhad test and you see that you are flying with somebody and they are in the middle of a divorce and their kids are having problems and they are in a custody fight, that's the person we want to say, hey, beware of that person. They may not be tracking. They may be out of the net at a key time. And those are the things we want to stress. And our program acts as a mediator, I would say, in that regard.

I reread what Dr. Billings had written at the end of that 1979 meeting and he was saying as far as using the simulator, is it really a training tool or is it an evaluation tool? And that's a key thing. I think it is not a training tool to start with in the behavioral science. You have to start with some basic information and you move on from there.

So, basically I have drawn some key variables we found in reference to our program.

DISCUSSION

DR. LAUBER: Thank you, Bob and Stan. I see hands in the air already. We've got about a dozen of them here, so the first ones I saw were down here. We'll work our way up.

DR. BENTHAM: I'm Dr. Jack Bentham. I'm a consultant with Metro Airlines. I've put some training programs in place in the banking industry and also in the utilities. The problem that we found was that there has to be a linkage between the training impact that Dr. Sellards is talking about and the actual accountability in the measurement environment so that we are training managers.

I'm wondering in USAir if you tried and found some success or failure in trying to get the pilots then in the cockpit to actually go through some behavioral change, measure it, get in a feedback loop to them and actually modify the behavior in a practice effect.

DR. SELLARDS: I would say that basically we haven't had a lot of different kinds of research -- that's one thing we're undergoing right now. We know from the feedback we're getting, a written feedback, that a behavioral change has taken place. We know that. We've got some guys that will say "psychology sucks", but they will still come up and say, you know, Doc, I think maybe I have been too much acting like a kid in that cockpit, or I'm really not allowing that new guy a chance to talk -- so that's the kind of things we look at.

As far as the hard data, we're starting to get some of that back, and we will know a little bit more than we know now. But there is behavioral change taking place and we also -- knock on wood -- we haven't had any serious situations.

I think that's the problem with all of this stuff: Where is your assessment tool and how do you know? We know people are saying we like it, and we know from the paper feedback at one level that it's good. I know for myself there is no question. I'll bet the ranch on it. I know that over time. But as far as hard data, we've got something similar to United. We can say, hey, pilots are passing at a better rate, or whatever. But we don't have enough research, our thing is bottom line, we want to cut down on the loss of life.

DR. LAUBER: There was another one here in this row, and then Dick Norman in the back. And then down there again, I guess.

MR. FISCHER: I'm Bob Fischer of Summit Airlines.

You are wading in some fairly sensitive areas there, and I would just like to say one thing. It seems like you are dealing with two problems. One is you are teaching an old dog new tricks; i.e., you have a highly technically qualified, very competent individual who has been flying the airplane for a while and now you are going to teach him how to behave so he can communicate effectively with people around him.

And secondly, you have a new hire who you are bringing aboard, and you are going to try to evaluate this person first as an individual and what he is capable of doing. And I think we probably have a higher degree of education today than we had 30 years ago when we hired somebody off the street to be a pilot.

So the question is: Aren't we really dealing with two problems? One is how to teach an old dog some new tricks if in fact he is a good pilot but hasn't learned to be a very

good people. And secondly, can we evaluate this when we hire somebody off the street, whether we have a good mature individual we're working with?

DR. SELLARDS: The first thing was old dog, new trick. Illinois University did an assessment on pilot error related to age. They (and I) don't think age is a variable. Age is not a variable in behavior, because you can be an ---- at 25 or at 65. Okay, so age is not a variable. The variable is personality type. We've kind of even addressed that old dog, new dog. To me I'm not sure that's valid. I'm saying I've heard that, you know, but that's more or less, I'd say, a behavioral situation that personality not age is the variable. You have raised two excellent points.

The point on teaching somebody who comes into that classroom. One guy who is going to retire in two months, we were just talking, that kind of a guy, he buys it but not on the surface, because he has family problems, and he is struggling with some personal issues. Now in answer to that, we find a lot of problems from guys who are 45, 50, 55 years old. There is a saying, the troublesome person is a troubled person. Nobody wants to fly with them and yet they are the kind of people who are struggling. So sometimes they are looking for an answer. So I think that's part of the problem and our program helps them.

You raised an excellent point. I'm not trying to skirt around it. I don't really know. Behaviorally old dog, new tricks; I'm not sure what that means, because a person will buy it at any age if they are receptive to it personality-wise, if they are ready for looking at their life for whatever reason.

The other issue is new hires. We haven't run through the new hires in this program yet. Part of the reason this program has been accepted, I think, is that the older captains see a difference between them and the new people and want to bridge the gap. And you've hit on education as being one of the things. So they are also looking for tools to bridge that gap, and I think that's the other positive part of this.

DR. LAUBER: Dick Norman.

CAPT. NORMAN: Dick Norman, chairman of pilot training committee for ALPA.

I've just got to -- I just can't hold back anymore -- and stand up here and get with you gentlemen. You are such a fine group of people. I do want to talk with Paul and Al later in some of these workshops in reference to the flight crew training technology and conditions in the country, as I

can see it and our committee do, throughout our working with all the airlines both commuter and of course the regionals.

Stan, both you and Robert, especially Stan there, the captain development training that you have developed, I think, is absolutely excellent. Our committee and myself personally have been through many of these training areas, especially with United, and I can see the effect of this captain development training and also the human factors portion that enters into it and the training that is so very important.

The question that I have may be directed more towards John, I guess, is just where are we going to go and how we can get this training distributed throughout the industry and what affect we can have through the FAA to require this. I think it is so very important in training.

All you gentlemen have seen so far this morning in what has been presented to you, is extremely important in the cockpit area. I've developed a paper here entitled "Training Pilots in the Area of Judgment, Decision-making and Cockpit Management" which I intend to present before the SAE symposium in Long Beach. It is copyrighted, and I wish I could distribute it right away, because it is in line exactly with both what these gentlemen have been discussing. It's a very important issue from the many years experience I've had in operation of aircraft as a pilot with Pan American. And the cockpit conditions I can see it is so very important what these people are talking about.

And my question, I guess, is really directed towards you, John. What we can do and what direction and what clout is necessary to go in this so we can bring this out to the industry? It's so very important.

DR. LAUBER: I'll give a very quick answer to that, Dick. I think we are in the process of doing just that by meetings such as this. I think that we've found, that as a result of being able to get industry people together to discuss these issues at meetings like this and then generating reports and disseminating those to the industry, that we've generated a great deal of awareness of the problems and the issues within the industry and I'm not sure what we can do beyond the kinds of things that we are doing now to speed up the process. I think there are many things that enter into it.

I think the industry has traditionally been relatively conservative with regard to changes in flight crew training, and I think there are very good reasons for that that apply in this case as well. I think we are just learning how to do these things. So I guess my answer is that so far as I

can see, Dick, we're doing it. And if anybody has any further suggestions as to how we can do more, we're open to hearing it.

We have several questions. Let's take one here in the back row.

MR. SKOUGAARD: I'm Dennis Skougaard of Big Sky Airlines. I remember reading a few years ago that Lufthansa had a program using biorhythms, and if they found pilots on the low side of the biorhythm scale they grounded them. What I am wondering is: In your program, if you have people that are under stress themselves or recognize people in their cockpit that are under a great deal of stress, do you encourage them to ground themselves or to come to you and say maybe so and so shouldn't be flying under the circumstances he's got to deal with?

CAPT. FICKES: Yes, sir, we very much encourage people to understand -- that's part of this education process for the individual who is going through some stressful experience to understand and come to us, and we will make arrangements for him to remove himself from duty. There are all kinds of ways you can do that. I can remember flying with captains back when they were going through maybe a marital situation, and they would sit and look out the window and not talk to me for hours. That's one hell of a situation to be in.

DR. SELLARDS: I would like to say one thing on that. One thing is biorhythms, per se, there are no scientific studies to support biorhythms. Now circadian rhythms is a different situation, but biorhythms there is no scientific study. You know, I carried a lucky penny in my pocket, and that got me through Vietnam. That's my belief. But I'm saying there is no scientific study to support biorhythms. So those kind of issues we talk about. That's a self-fulfilling prophesy - I'm going to have a down day. So we talk about those kind of issues, and those are good issues to address, that's an excellent point.

And the other part is we do have phone calls from pilots who say, hey, I don't want to fly for a while. And they see me or somebody else till they get the situation straight. We are hoping for a payoff there.

DR. LAUBER: Another one right here.

MR. BLUME: Bob Blume of Imperial Airlines. You got real close to a good point, and that is when a guy comes up to you and says I'm under stress; my marriage isn't going exactly the way it should be going; or my dog died; or whatever, you pull him off the line, and he doesn't adjust

or he doesn't come back. What do you do with him? I'm sure the union would be interested in it.

CAPT. FICKES: Well, we deal with the issue. The point is that he is off the line. We've identified the problem, and we're trying to correct it. And that's not always necessary. Frequently you can have discussions and work things out just ventilating and get the gentleman back to work much quicker.

MR. BLUME: Have you ever used any of the training or any of the self-evaluation things, and, you know, to get back to what you were talking about, use it as a profile for a new hire or for an upgrade to your advantage?

DR. SELLARDS: No. We have stayed away from that whole issue.

MR. BLUME: Simply because it would be threatening to the people who are taking it?

DR. SELLARDS: Absolutely. We want the assessment to come from inside the individual. So that's an excellent point. We haven't touched that at all. In fact, when we started, that was a big thing was that we were going to psych out all these people. You can't do that, first of all.

DR. LAUBER: One here.

MR. BREWER: Chuck Brewer from Summit Airlines.

My question is: We talked earlier about instructional technology and the ability for a ground instructor not necessarily to be a mechanic but understand what he's teaching. And from the cockpit resource management concept, would you advise anybody going into this, when you start talking transactional analysis and behavioral management and changing, to have someone like yourself, a doctor, as opposed to someone on staff? It seems to be a very qualified field, in which case I think we are looking at how can we do this and what should we do to do it correctly, and can we really pull a senior captain or someone we think is a nice person. Or should we be looking at a consultant like yourself to run a program like this?

DR. SELLARDS: I think you hit on a key point that even if it's an outside person, you know, the old thing about the experts are anyone 50 miles from home. The other point is, yes, you do have to have somebody who is qualified. I think some of the programs haven't flown as well perhaps because the instructor wasn't well qualified.

So you hit on a key thing. Yes, number one, it should be an outside person and, yes, they should have credentials. When I'm flying with somebody, I don't want somebody that isn't credentialed in that left seat flying that aircraft, and I would want the same thing in a training program. Not that they are going to be that much difference perhaps, least they have a credential. They've jumped through the hoops the same way the pilot has jumped through to get credentialed for flying, so if you want to use that similarity. That's an excellent point.

DR. LAUBER: Ed Carroll.

CAPT. CARROLL: Ed Carroll from United.

I want to address something that Dick Norman raised, and I think the last point that Bob just made is indicative of what I am going to say. Each of us who are going to make an approach to this today, I think you are going to find, have slightly different approaches and interpretations of parts of the program. And with that in mind, when we put our program together I went to the FAA in Washington before we started it to make sure of two things: one, that they didn't have any real objection to what we were doing from a regulatory sense, and two, if they ever thought about making it a regulation I didn't want them to reinvent the wheel. I figured if we had something going that they could address, then they wouldn't have to start from scratch.

So I guess what I'd like to say to Dick at this point is we all believe that this kind of training should be done. But until we have resolved exactly how the training should be addressed, I don't think we want to push too hard for regulatory approach for this yet, although I really believe it will come in the next couple of years. But when we resolve our own considerations and differences, then we are in a better position to approach it; otherwise you are going to be going four different directions while you are waiting to decide what is the best way to approach it.

CAPT. FICKES: Could I just respond to Ed's statement there? I agree wholeheartedly with you. As I mentioned earlier, we are talking methodology here, gentlemen. What works for us won't work for somebody else or whatever. I think it is important that we understand the bottom line of all this, how effective it is and so forth before we all race out and start writing new rules and regulations.

CAPT. NORMAN: Just a moment. I'm taking this from Paul here. I want to reply to the two gentlemen. I certainly agree with you on that. It's not the fact, as I said, we need the clout in there. It probably wasn't the right phraseology. But we do need to address this, as these

gentlemen said, and I'm addressing it by the mere fact of experience and exposure over many years and watching conditions.

And we are approaching this area, as it was just explained from our gentleman from United there, that in probably two or three years this will come about. I'm not for regulations any more than anybody else is, but I feel this is a very important area, extremely important area for air safety. So I did want to make a fact of that for the record. Here's Paul, one of my members.

MR. ISTOCK: Thanks, Dick. He's my boss; what can I say? Beside working for Dick, I fly for Delta. And I have a question for Dr. Sellards.

What is your opinion of psychological testing via interview, et cetera, before an individual is hired as a method of preventing some of problems that we are talking about?

DR. SELLARDS: I don't do this full time, but I would say you've hit on a good issue. I'm amazed that there aren't more tests done as far as identifying problem people at some point. I want to address the other point that was raised. We know some educational truths that are around us. It isn't necessarily an unknown area -- there are some firm proven methodologies. There is plenty of data out to support and answer some of the issues being discussed -- so whether you do it this way or that way, we know that there are some educational truths on how you arrive at a goal.

The other point, though, I would agree that I am amazed that there aren't more tests developed -- there are some valid and reliable tests out there to do some identification like that, and I'm amazed that we don't do that. That's an interesting point, too, because we have guys in our class say that the union protects the very people that should be thrown out of the cockpit. So that's an interesting dilemma there, too. They'll say we've got to get rid of this guy, but you've got to be caught with a smoking gun and a dead general before anything is going to be done. So that's another interesting Catch-22 in the whole process. And even in the psych testing part, I think that's written in the new union rules that there won't be any psychological testing done on pilots. Now in the med schools we are teaching physicians that a mental status report is as useful as drawing blood. So it's a good point.

DR. LAUBER: Did you have a quick comment?

MR. LIDDELL: Roland Liddell with ALPA. One comment is too that when you are talking about screen tests that people

change. And 20 years after someone is hired, many things will change in a person's personality, so that you look back and say why did we hire him?

But professional standards. Have you looked at USAir into a group of pilots that would handle problems in your cockpit, whether it be a co-pilot, flight engineer or captain or whatever, that you can refer these individuals who might have problems to a group that will try to solve these problems, and this will stay away out of the managements' information source?

In other words, within the union group do you have a group of pilots that handle problems and again the management is out of the loop, so to speak, so these problems can be dealt with completely anonymously and try to solve the problem before it gets so gigantic that it might affect someone's termination or whatever?

CAPT. FICKES: Yes. I'll respond to that. Within the ALPA group there is a professional standards committee which functions in our airline as it does, I'm sure, in every other one. Unfortunately, as Doc said, frequently it takes a smoking gun and a dead general to get any action.

In this particular program we are not interested in testing people, setting up profiles and really getting into that area. We are interested in education. We feel that there is an awful lot of ground to be ploughed in education. And you start tacking on assessments and that sort of thing and special study groups, and the first thing you know is you've got a real problem. People do not accept the program. It used to be called Fickes' charm school. Now people are trying to get in there, because we stay away from those very sensitive subjects.

DR. LAUBER: Thank you again. I'm sorry again to all of you whose questions we couldn't get to. We'll try to work them in at some point. You are about to have a unique experience, and that is eating at the Ames cafeteria.

(The noon recess was taken.)

We are going to continue on in the same vein and that is to take a look at another program that deals with the co-called nontechnical side of flight crew training.

Jim Sifford, who is director of flight standards at Piedmont Airlines, has been with Piedmont since 1959, and has flown all of the airplanes that Piedmont has flown in that period of time. He is rated on both Boeings, the 737, the 727, and he is also a member of the ATA training committee and was vice-chairman of that committee in 1982.

His colleague, Hugh Huntington is vice-president of Organizational Consultants, Inc., in Charlotte, North Carolina and is working, as a consultant for Piedmont.

He has graduate degrees in business and psychology and is principally interested in problems having to do with group dynamics and organizational behavior. I think you will be interested in the approach that Jim and Hugh have taken at Piedmont in integrating these elements into their program. He does a lot of work similar to what he's doing with Piedmont for other industrial clients, so he has a good background and good deal of experience in doing these kinds of things.

With that I'd like to turn the podium over to my friend, Captain Jim Sifford from Piedmont.

MANAGEMENT TRAINING FOR COCKPIT CREWS AT PIEDMONT FLIGHT

J.C. Sifford

Piedmont Airlines

CAPT. SIFFORD: It is also our pleasure to be here today to be presenters to this group that we've worked with for quite a while and I look forward to working with in the future.

There are a couple of comments that were made earlier that I might just address to save questions later. I think it is fortunate that we got to go second and hear some of the questions that were asked of everyone.

When we developed the program, Hugh Huntington and I set forth a couple of goals that we wanted to work as far as what would be covered in the program, of course, and some of the type things that you would imagine: What do we want to train the pilots; when do we want to do it; what's the best time, prior to simulator, after simulator, before the oral, after the oral; should they be relaxed and airplanes off their mind, not worrying about their FAA check or company check? These are many of the things you will be faced with when you develop a plan.

We also went to the ALPA committee, which I think is essential in order to get the backing of the pilots. I think they need to be contacted, and we worked closely with them in the development of the program. The program on our part is completely voluntary. We asked the people would they like to participate. We contact the division chief pilot, and we say send us some pilots.

We've gone one step farther with our program. We try to group trainees by seniority. That's to say, we don't want a captain that's just checked out to be in the same class with a captain that's been a captain for 25 or 30 years. We feel like it's a more free exchange of information between the group which Hugh will refer to later. And we think this is a way that works best. Fortunately or unfortunately as the case may be, we have not worked our way up very far. We are at about five percent of our pilots. The reason is obviously trying to get the people off the line. We are paying \$240 or \$250 a day for the training, so we are paying quite a price for it as it is.

Another thing is we have no specific feedback back to

the management people. Hugh runs the school. We have some other management people that participate in it. We will explain the scenario of the school here momentarily. But as far as what Hugh does with the pilots, we have no paperwork that comes back. We just have a record that they attended the school. As far as which courses or grades etc., we keep no record of that, because we don't feel that's important to us.

I believe it was Dick who asked a question earlier about teaching an old dog new tricks. We've addressed that one, but we're not so sure we're really trying to teach this dog any trick at all. We think that we are rather -- we'd like to look at the tricks he knows. And that's to say that we have no illusions about changing the pilot's basic behavior traits in two days or probably two weeks. So what we endeavor to do is to point out to him, these are some of your weaknesses, how about looking at them?

One of the traits that came out of my class was that I'm a very stubborn person according to this instrument that Hugh used. I'm all the way in the bottom left corner. Now, he didn't tell my people that, they knew that already. They were too polite to tell me. I now realize that once I take a lot of information as this test indicates, and once I've made that decision I was very low, like five percentile, and the rest of the people 55, so I'm damn bullheaded according to Hugh. This is the type of thing that I try to be aware of now, and I suppose this is something someone could have told me this earlier but were too nice to.

Also the regulatory thing was mentioned a little bit earlier. In my opinion on the regulatory issue, I think that if the regulations are developed they should be similar to our training programs now whereby the regulations would indicate that the pilot should be trained, and I guess very similar to regulation by objective which is no longer with us.

It was mentioned earlier that one airline may tend to go into nuts and bolts, and another carrier may decide this not necessary. The FAA takes no position on that. I agree there are three, four or five or more ways to do this job, and whatever regulations are adopted should reflect this fact.

I will not attempt to give you a complete history of the airline, and I'm not going to ask questions later, but I know some of you don't know what the Piedmont Airline is, you've never heard of it before, so I would offer a brief overview of the airline's history so you can know where we came from also. We are a very small airline, and we still are a very small airline.

Piedmont Airlines is the largest division of Piedmont Aviation. Piedmont Aviation recently bought Henson Airline which I'm sure many of you are familiar with. We are a separate identity. They are just a part of Piedmont Aviation as Piedmont Airlines is. So we cross no boundaries at this time so far as training is concerned.

We took our name from a region in North Carolina. The Piedmont area is between the mountains of North Carolina and the coast. Translated, the word is a French word that means small mountain.

The airline began operations in 1948 with a fleet of three DC-3s. And the original route became an instant success. It offered service from Wilmington, North Carolina to Cincinnati, Ohio, and westward across coastal plains to the hills of North Carolina. It was over a large and undeveloped and inaccessible Appalachian Mountains that most of those cities are, bounded by North Carolina, Tennessee and Kentucky. The route continued on across Kentucky to Cincinnati.

By September 1948, the original route had grown considerably. It expanded within six months to include 21 cities.

In 1968 the route system had expanded into the mid-Atlantic states spanning the basic Wilmington - Cincinnati route up to New York to the north and Atlanta to the south and Memphis to the west.

The flight equipment included at that time F-27 aircraft. We later switched to Martin 404s, FH227s, and in the '68 time frame we went to the 727-100 aircraft and finally we bought 21 of the YS11s which gave way to 737s. During the 70s the airline grew all the way out to Denver, down to Dallas and Chicago. thus this unprecedented growth within Piedmont clearly defined a need to develop a management program for our captains. To give you a few examples, Piedmont expanded from a 51 aircraft fleet in 1977 to 84 "all jet" in '82. The plans have now been completed to take on 20 Fokker type aircraft, F28 aircraft, and they will be arriving sometime next year. We are also operating a fleet of 727-200s with more of those to come, so we are in quite busy with training. For those of us in training, there are a lot of unanswered opportunities for us to do something. By the mid to late '84 season, the fleet is scheduled to be about 180 aircraft. So we still have a bit of training to do.

In 1977 the pilot seniority list was at 377; today it's over a thousand, about 1,050. So the check out period in 737 and 727 is now four years for the captains since they've

been with the company, and it is expected to shorten considerably with the addition of the F28 aircraft.

Prior to now, we depended on our senior pilots to teach or to pass along the flavor of the airline to the less senior employees. This included the flying skills as well as the cockpit managerial skills.

In order to ensure that the necessary cockpit managerial skills were to continue and be passed on to the crew, we felt it was necessary to contact Hugh and his group to help us design this program. And we also looked around at several of the other operators that had developed programs. We talked to several people about it, and there again I think you're going to see a lot of similarity but not exactly the same program. There is some different philosophy within the program that we have and as you can see in the other airlines as well.

Our first thought was to offer a two-day seminar to our captains concerning aspects of supervision, which is another way of saying resource management or cockpit management; call it what you will. The course was to be developed using current as well as exploratory techniques that would acquaint the crews with the very basic idea of self-analysis, which we hoped would benefit the airlines by having a flight crew serve as a catalyst for retaining the traditional Piedmont flavor as it had been for the past years.

After the course structure was planned it was presented to senior management for the necessary plans for implementation. Senior management became very enthusiastic about the program and offered many helpful ideas and suggestions of how they could be included in the program.

An observation here at Piedmont had been made, and it goes something like this: The captain is the one common thread running throughout the airline, and that the aircraft and consequently its crew is what all the departmental goals are set towards. They are all aimed at getting an aircraft and crew safely airborne and its seats and cargo holds filled with revenue producing customers and cargo in the most efficient manner possible. Therefore, if the crews in their day-to-day contact with the customers and support personnel could reflect the image that senior management wants to convey, this would be a very effective vehicle for meeting our corporate goals.

Mr. Bill Howard came with us five years ago as the president and chief executive officer of the company. The senior management not only approved the funds for the seminar but graciously agreed to participate in each

seminar.

Mr. Howard himself feels that the program is of sufficient importance that he spends two to three hours with the crew or the training captains each time they have a meeting. This active participation on his part is one of the highlights of the Captain - Management Seminar, as we call ours, and I think it's probably one of the keys to its success to have that level of management support behind it.

Without exception, the crews feel that if Piedmont executives take time from their busy schedule, the president in particular, to talk to them and answer questions that their company is truly interested in them as a company representative. The active participation of the president tends to assure that other senior top level management people make themselves available as well.

The vice-president of flight operations and the director of flight ops host the participants to a dinner the night before the program. We normally start it on a Tuesday, and on Monday night they show up and go out to dinner at one of the local restaurants. We feel this is a pretty important part also. This tends to be one of the highlights, because as you can well imagine we are getting away from where we knew everyone by their first name and their wife and their children and where they live. We've grown too large for that, unfortunately. We don't know all these people by their first name, and I'm sure some of the rest of you are in the same position today with your growth. It's helped us in flight ops to be able to answer questions and establish a line of communication with those captains that we don't believe we would have had without this participation at the dinner. So we feel like this is a very important part of this program.

Among the other participants is the senior vice-president of marketing. He discusses with them generally crew communications and how they can influence and make a definite positive impression on the customer.

The vice-president of maintenance stresses the importance of crew participation in the maintenance areas and there is generally an overview of the support required to get the aircraft aloft.

The vice-president of finance discusses with the pilots how they can affect the profitability picture through decisions they make. We all know they can affect the profitability picture quite a lot.

Management participation is now at such a level that we are thinking of increasing the course length. We started

with a day and a half for management and now it's up to two days. We think we are going to increase that part again. I should explain that we have a four-day program. Hugh has two of those days, and we use the other two for technical things such as the Federal Air regs, visitation to the executives of the company and this type thing. So by increasing it one day, Hugh will get about a half a day of it and the other half a day will be for technical skills such as the Federal regs, the minimums, and this type thing.

As I mentioned earlier, this is a brief overview, and I have not attempted to discuss the managerial program in detail. Rather, Hugh of Organizational Consultants in Charlotte will do that. I would like to mention that we intend to increase the scope of the program, and we are going to not only involve the junior captains with the program; we are going to get the senior captains involved as well, just as soon as time permits. We are working from the bottom in seniority up in groups as best we can as I explained earlier.

We've appropriated monies at the present time for development of a new program, and this one is going to be a "train-the-trainer" type program where we intend to get our check pilots involved. They have already attended the captain school. We are going to develop a program just for the check pilots, so they will be able to make observations and give us feedback, not on the individual but how this individual acts, as someone mentioned earlier, under stress -- this is not a gradeable-type thing. It will be the type program where he will be able to act with the crew and make suggestions on a one-on-one basis. So the train-the-trainer program is just around the corner.

We also intend to involve the flight attendants with this program. We were talking with the flight attendant department and they announced that they can also be a part of it and possibly down the road station agent type personnel. The idea being a circle around the captain.

We've been very satisfied with the program right now. Some of this will be included in a phase two simulator LOFT program -- the LOFT part that's post type rating. We are going to do some feedback in that program which Hugh can mention a little bit later.

In general we are very pleased with the program. Anything we can help you with let us know, and we will be happy to answer questions later.

Hugh Huntington, Organizational Consultants, Inc.

MR. HUNTINGTON: Thank you, Jim. I want to say also thanks to Bob Sellards for opening up the behavioral piece this morning. Sitting in the audience, I was very aware that each time Bob made a controversial statement about behavior, the audience squirmed. It points out something that I'd like us to be aware of here. When I make statements that make you uncomfortable or make you want to squirm, be aware of that. Let's look toward tomorrow by looking at some of the differences that we really struggle with. Most of you come with a very technical background, technical training, left brain dominant, analytical thinking. We are talking about right brain type of activity here, so try to be aware of your uncomfortableness from anything I may say to you.

Let me just make a couple of comments so you can understand the framework in which we developed the program for Piedmont. My company specializes in designing programs for organizations, particularly those that are in the midst of change, and, obviously, Piedmont is very much in the midst of change. Our specialty is in group dynamics and organizational behavior, and our sensitivity to group dynamics, we felt, made us quite useful in captains' upgrade training, the training of new captains.

The research we did was a classic training type of research. We did all sorts of reading, scanned all sorts of data, used a data research group and scanned over 400,000 pieces of literature in six different languages and came up with all the information we could on leadership training, flight crew activities, causes of aircraft accidents, et cetera, and edited that down to about 21 inches of stacked reading material that covers all the familiar names that you would know, like FAA and all the accident reports.

We did extensive interviews with captains; flew about 12 days in the cockpit; saw all kinds of things. We've seen all sorts of mistakes the captains make. We've seen Attila the Hun in the left seat. We've seen the captains that won't make decisions. So we've seen the whole spectrum, we feel.

After all of that research we then sat down and designed the program. We designed it around several issues. The first, of course, is looking at flight safety and how do you make sure that Piedmont maintains its high safety record. We realized that depending on whose data you look at, as much as 80 percent of aircraft accidents are caused by or significantly contributed to by ineffective behavior

in the cockpit. So working around that data became a major portion of the focus of the program.

The second step was to look at the managerial aspects for the captain and how he could begin to perceive himself as a manager. So we referred to him as the branch manager or mid-manager in the organization. We used some simple financial data to help him focus on the purpose of the airline, and then begin to tie his behavior to the attainment or nonattainment of the airline's purpose. So we link the intellectual side of what's the purpose of the organization with his behavior and make him a key piece of that. That's the way we introduce subtly the behavioral aspects of what's happening, and introduce to him the concept that he's responsible for the behavior dynamics inside that airline.

The third aspect, of course, is addressing Piedmont's major change. They are growing from an organization that had three or four hundred pilots four years ago and now they are up to 1,050. They had traditionally been a southern based airline hiring predominantly southern born and raised and grown up pilots. And now the resource base is dry. They've grown so rapidly. Laws required that Piedmont hire Braniff pilots. Piedmont crews were concerned at how to maintain closeness, our unanimity, our sense of oneness in the process of all this change. So we have also helped them address that through the program by teaching each captain that his behavior can help maintain that sense of closeness.

Now, I'd like to take a look at our purpose here today. The first is to review Piedmont's approach to cockpit resource management; the second, to look at the relationship of cockpit resource management training to other aspects of flight training; the third, to review future leadership research plans and cockpit resource management training, things that we have in the works; and fourth, to help us prepare for our work sessions tomorrow by raising critical training issues which we all have in common.

Let me comment a little about the captain's leadership program at Piedmont. The first objective is to teach each new captain how to be aware of the positive and negative effects of his or her leadership style and how to minimize the negative effects. The second objective is to find value in, rather than fault with, another crew member's personal style of interacting. Third, we want to create an awareness of the individual's contribution to unsafe situations and offer skills to eliminate those situations. Fourth, we want to improve crew coordination and decision making. And finally, fifth, we want to teach the captain how to create an atmosphere which will best enhance crew performance and safety, and passenger satisfaction.

There are several assumptions underlying this program. The first is that there is no one correct leadership style for all situations. It keeps us from being judgmental about the individual's particular leadership style. Second, there are leadership styles in certain situations which are more effective than others. That allows us to address the truth that particularly in combinations of personalities as opposed to a single individual. Third, preexisting relationships in the cockpit either have a positive or negative effect on the capacity of the crew to be sensitive to and respond to unsafe or emergency situations. Fourth, different combinations of crew member personalities will affect the behavior demonstrated in handling a problem. And finally, effective leadership styles are most easily attained by teaching captains how to find value in rather than fault with another crew member's style.

One of the things I'd like for us to do here today is to get a very brief sampling of the type of behavior piece that we work with. I want to take a few minutes and have you experience very briefly the initial piece of what it is that we do with the issue of behavior and self esteem at Piedmont.

Let me ask you in the audience to speak up: Tell me, if you were looking at an individual, how would you know that that individual was not feeling good about himself? What would you see or hear? Give me an example.

A VOICE: A lot of criticism of other people.

MR. HUNTINGTON: All right. A lot of criticism of other people.

A VOICE: Posture.

MR. HUNTINGTON: Posture. Slouching, stooping. Okay, what else? Give me more examples.

A VOICE: How he perceives his self worth. Ask him what he can do for the company; if he doesn't give you a good answer, he doesn't think highly of himself.

MR. HUNTINGTON: Okay, he doesn't think highly about himself if he can't identify with his company and talk about his purpose in that company.

Other examples. How do you observe people not feeling good about themselves?

A VOICE: Dress.

MR. HUNTINGTON: All right, the way they dress; they're

sloppy, their shoes aren't shined, their necktie is hanging crooked or whatever.

What else?

A VOICE: Apathy.

MR. HUNTINGTON: Okay, how he filled out his job application. You might even look for whether there is much there or whether there are a lot of lies there.

All right, let's talk about the positive aspects. What do we see when somebody is feeling good about themselves? What do you observe?

A VOICE: Smile.

MR. HUNTINGTON: A smile. Give me more examples.

A VOICE: Interest in others or interest in other things.

MR. HUNTINGTON: Good, interest in others.

A VOICE: Somebody who can listen.

MR. HUNTINGTON: Good, somebody who can listen. Good, excellent. What else?

A VOICE: General positive outlook towards the company he is interviewing with and his past employers.

MR. HUNTINGTON: Constructive outlook, positive attitude.

We could keep building this list. What I want to do by asking you these questions is to demonstrate that we already know what we are looking at when we see somebody who is feeling good about themselves or not feeling good about themselves. So there is no magic in the "sharing" side of this training program. We in this society, particularly males, are not taught to look at behavior. We are taught to look at facts. We are rough and tough. We don't cry, et cetera. In fact, all the behavioral data we need is sitting out there. It is right in front of us.

By teaching a captain, in this case the captain is a manager, to be aware of those types of behavior including his own, then he's in a much better posture to control how the other individual is feeling about himself. What we know is when we feel good about ourselves we can tackle just about any problem that comes along. It doesn't much matter what that problem is. I'm sure most of us being married at

some point in time, walked in the house and your wife says: "Let me tell you what the kids did today." And your response is: "Well, honey, let's sit down." Then you walked in the door on another day and she said: "Let me tell you what the kids did today." And your response is: "Leave me alone. I don't want to hear it. It's your responsibility." Well, that's a simple example of differences in behaviors, even though the events were the same. In these two situations, we are looking at examples of high and low self-esteem.

Well, the point in looking at the issue of self-esteem is that the better we feel about ourselves the better we are able to respond to a particular situation. What we want to do then with the captain's self-esteem is teach him how to keep it at high levels.

(Figures Unavailable)

This slide begins to depict, then, the first of a series of interactions on how we address the captain's leadership program at Piedmont as total resource management of what goes on in the cockpit. If you will, turn to the second sheet there in your handout, and there is an exercise. I'd like you to take only about three minutes apiece. Let's make this brief as a demonstration. I want you to think about captains you have flown with. If you are not a pilot, think of your boss. Think of a captain you've flown with who was the best captain you ever flew with. Think about the things he did with you or said to you or instructed you to do, his attitude towards you. Make brief notes about that. Make as many notes as you can. This is for your use, so make them brief. Take about three minutes to do that.

Now look at your other list, if you would. Think of the captain that you have disliked the most, that Attila the Hun in the left seat. Think of all the things he said or did or his attitude towards you. Make some brief notes about that.

[Three minute interval.]

Let me ask you to stop at this point, and I will return to this example in a moment once I have explained the model to you. Let's look first at the content of the leadership program. First, we focus on the captain as a manager and we use experiential education, which is a group activity involvement where they reflect on their own behavior as opposed to lecturing to them about the best way to communicate.

We focus on the concept of self-esteem and its

influence on behavior. We use three different test instruments to measure leadership styles and conflict handling practices, including one which we've developed on a grid pattern. I was interested to hear that Bob has also done the same. It is an instrument developed strictly for captains, as opposed to a managerial instrument that can be used anywhere. We are in the process of trying to validate the data. There is a lot of statistical work to be done, so it's by no means a clean, pure instrument at this point.

The captains' reaction to seeing their own data is fascinating. They develop an understanding where they stand amongst their peers. So we found that not only do we have a better instrument to tell them their style, but we are also able to show them how they rank with their peers. We use numerous cases addressing cockpit crew flight attendants and ground crew type of interactions.

We also use experiential exercises including video cameras where they are able to look at their behavior in the midst of these exercises. For those of you that have not used video, it is fascinating to look at yourself and your mannerisms. I remember the first time I saw myself, I couldn't believe how serious I looked. People hear their voice tone and are surprised that they are that critical. They see their hand bouncing up and down in a nervous twitch of some sort and weren't even conscious that they were doing it. They hear their deep breathing through the microphones. So it's a real eye opening experience from the personal experience, or learning, standpoint.

We do a lot of feedback on their individual strengths and limitations of particular management styles. We particularly look at the limitations aspect and see how that combines to form a dangerous situation with someone else's style. And yet how with another combination of behavior might not be dangerous at all. So we particularly point out to them the situational volatility. Then we compare the personal data to other class members to demonstrate the multiple combinations of behaviors that are involved.

This slide is a list of the positive kind of behaviors people demonstrate when they are feeling good about themselves. Notice how similar this list is to the list you developed earlier. They are self-confident. They are joyous. They are more open; less defensive. They have a high sense of creativity when facing problems. They are caring people. They are more expressive. They have courage. They express candor and honesty, a high sense of dedication. There is a uniqueness about them as an individual. They are spontaneous. And a significantly enhanced improved listening which is very critical to a captain in our opinion. The bottom line is that they like

themselves.

What's the negative aspect of low self-esteem? They are nonadventuresome. They are defensive. They are suspicious. They are unrealistically fearful. They are self-centered. They are withdrawn. They listen poorly. They are irritable. The base line there is they don't like themselves.

The model we work with focuses on self-esteem. Let me explain the four sources, and we'll shortly get back into your list. As you look at these four sources, you might think about your own list and be looking for those things where the captain would have encouraged your sense of self-esteem, or in the case of the bad captain they would have detracted from your self-esteem.

The first is having a visible achievement of a goal or accomplishment. That may be attaining the rank of captain. It may be learning to fly. It could be cutting the grass. It could be polishing your car. Whatever it is, it's the attainment of a goal.

The second source of self-esteem: The enhancement of power and control and influence over events and situations that are important to us or to that particular individual. We are not talking about political power here. We are talking about the ability of that individual to control his life and make it function in the fashion that he wants it to function. And anything that lowers his sense of self-esteem.

Outside circumstances; for instance, marital stress, divorce, a very sick child, a problem child, a car wreck, and numerous other things that are beyond the person's individual power to control cause a tremendous decrease in self-esteem. Research in factory settings, not with Piedmont pilots, but I think there is probably some correlation, indicates the prime source of self-esteem in manufacturing environments for males is power. Initial indications are 50 to 60 percent of our total source of self-esteem as males comes from that one element.

The third source of self-esteem is being cared about as a unique, valuable and worthwhile person; being treated with respect. A simple example of that is you walk past your boss or chief pilot in the morning and he doesn't speak. Most of us may think, gee, did I forget to put my tie up? What's the matter with me? Do I have bad breath? If you watch TV, everything between the color of your hair and the shininess of your teeth and the shoes you wear determines your self worth. So we have been taught as a society to react to those kinds of things.

A clear sense of not being valued and cared about as a first officer is demonstrated by a captain who acts like you are not worthwhile as you sit in the right seat, that your opinion does not count, that you probably have no information that he has not thought about. And that type of captain lowers the co-pilot's self-esteem.

The fourth source of self-esteem is behaving in ways congruent with deeply held values and beliefs. That is something, of course, that is very individualized. We in this room probably have many that are in common; however, mine might be a little higher in my priority ranking than yours, and vice versa, something is higher for you. When we are living outside those values and beliefs, we get ourselves into a position of lowered self-esteem.

An example of that is a captain that has very strong religious values and is flying on Sunday morning. We don't look at that as a particularly big deal, and you might not see that a whole lot, because people become accustomed to it. A captain who believes he really ought to be at home with his children, because he has a lot of strong values for his family, but chooses to be on the airline flying, has a real contradiction there. So when you ask him to fly an extra day and he reacts angrily with you, the whole issue may be guilt about leaving his children as opposed to not wanting to fly with you. Those are the four sources.

Look at your list for a moment, particularly the negative list and see if you can come up with examples of how your self-esteem is lowered. From the audience, somebody give me an example of something that was said to you or done off of that negative list.

A VOICE: Failure to praise when praise is due.

MR. HUNTINGTON: Okay, failure to praise when praise is due. What source of self-esteem is adversely affected by that type of behavior? Okay, number three. Clearly not being valued or cared about. If praise is due because you've done a good job, then you probably also achieved something like a good landing in bad weather.

Give me another example of how you were treated inappropriately by some Attila the Hun captain.

A VOICE: The captain said it was my leg to fly, yet he told me when to turn, when to level off, when to decrease power.

MR. HUNTINGTON: Okay. The captain told you when to level off, decrease power when it was your turn to fly. What's the source affected there? Number two. Clearly you

have no power and influence in that situation. He is the captain. And from a leadership standpoint I believe somebody needs to be in charge, but when he keeps telling you it's your turn to fly and then tells you when to turn, obviously you are out of control in that situation. And that's a potent way to decrease self-esteem.

I could keep going with the list, but in the interest of time, you've seen the fundamental model we are working with to illustrate how, if a captain continues to treat his co-pilot in a fashion that lowers his co-pilot's self-esteem, he winds up with a useless resource in the cockpit. He winds up with somebody who is angry at him, who withholds information, who doesn't respond to situations appropriately.

We all know that we all know how to get back eventually. And I've unfortunately been told of a number of circumstances where co-pilots got even. The subtle little things like not telling the captain he hadn't put the landing gear down, and they are a hundred feet off the ground. That kind of behavior is explained, "well, if it had been an unsafe situation I never would have done that." Suppose that he had a power failure at that point just as he is ready to say shall we put the gear down? They might have landed then with the gear up. As we read the data out of the accident reports, these type of behaviors are evident.

This is the model we work with. If those four sources are working well, you have an increased sense of self-esteem and a more positive self image. Coming down the right side of that chart we see the positive list of behaviors that we saw on the screen a minute ago. There is an improved sense of personal and organizational performance. When the captain is feeling good about himself, things tend to go well for him. He's the type of captain people like to fly with. So what happens to his self-esteem then? It goes up because they like to be with him. And so it becomes a cycle.

The cycle operates exactly the same way but in reverse. If the captain is feeling grumpy, no one wants to be with him. And when nobody wants to be with him, he starts acting more cantankerous than he was to begin with. And so he is destroying everybody else's self-esteem around him, and then he feels worse about himself. So the behaviors become worse. That's the self-esteem cycle. What we teach the captain is that he has the choice of enhancing or detracting from the co-pilot's or the other crew members' self-esteem. And to that extent he is responsible for what goes on in the cockpit.

We look at self-esteem and draw on three primary

functions of that. Home relations; that includes sick children and everything else. We look at cockpit crew relations, and we look at other crew members relations such as the flight attendants and the ground crew. We tie all that in to safety and finally in to the customers' satisfaction. The way the captain treats the flight attendant affects the way the flight attendant responds to the passenger. And the passengers, satisfaction or dissatisfaction determines whether they come back or not. That affects airline profitability; that's the purpose of the airline.

The second piece that we are doing now, that I want to tie into the cockpit resource management, we refer to as train-the-trainer. Content for the train-the-trainer consists of adult learning methodology. To get to the truth of it, it is literally learning methodology. But adult learning methodology sounds much better than child methodology.

We are in the process now of designing this program and hopefully will have it ready by the end of November. What we are teaching the check airmen to do is to recognize the various learning capabilities of the individuals that they are training. A series of techniques that are involved in that, Bob mentioned this morning right brain, left brain.

Let's do a brief experiment. Hold your thumb up and center your thumb on my face as best you can. Now you're going to see a little bit of a double image. But stick your thumb up and center it on my face as best you can. Now holding it there, close first your left eye and then your right. Note which eye best covers my face. If your left eye best covered my face, you are probably right brained. If your right eye best covered my face you are probably left brained. That's not a scientific methodology we just demonstrated here. What we do know is that it's a pretty rough correlation. We also know that most of us have varying capabilities in those two fields. Maybe it's 60/40, 40/60, whatever the distribution, but we tend to be left brain dominant in this society, because we teach the people to be so analytical. Our pilot training process teaches people to be left brain dominant.

If the individual is left brain dominant, and I make a comment like "let's see if we can visualize in your mind and be creative here", I just lost that student. On the other hand, if the student thinks very visually, creatively, and conceptually, and I say, "folks, the facts are there, now use your head and analyze it", I just lost that student. There are a whole series of other ways that you can look at adult learning methodology, and I will not attempt to go into those. The point is if you are looking at effective

training, your trainer has to be well prepared to respond to the individual at his best level in order to enhance the learning that is taking place.

We use some instrumentation to test learning styles, and these are simple instruments. We look at the implication of brain hemisphere dominance on the individual's learning and the trainer's capacity to respond to that trainee's need. If you get a heavily dominant left brain trainer, then you are going to have a limited trainer. Heavily dominant right brain, you'll also have a limited trainer. So we are looking at trainer selection as another issue.

We are looking also at how to establish positive attitudes in the initial training as well as the check ride situations rather than the pass-fail, win-lose atmosphere. I don't observe that pilots feel comfortable sitting in there, the simulators and I think that adversely affects their learning. If they are there for learning and proficiency, then let's treat them that way, by creating an effective learning environment.

We are also looking at how to best critique a LOFT scenario from a crew interaction standpoint. I am in the process now of developing, with Piedmont's funding, an assessment criteria format. Clay Foushee with NASA has been an invaluable resource in developing an assessment procedure to help the check airmen review the interaction behavior dynamics that are taking place particularly in the LOFT scenario. This can also be done sitting in the cockpit riding and making the observations, so the captain can become aware of his particular interaction style and how that form of communication either adversely affects or positively affects the first officer's position as a resource in the cockpit.

In the process of developing that, we are also going to be working on feedback skills, teaching the check airmen how to more appropriately give feedback instead of saying, "why the hell did you do that?" or "that was stupid" or, "gee, dummy, let's go through that again." More effective skills will enhance learning than that kind of traditional methodology.

Also we are going to teach the check airmen how to give feedback on leadership styles. Someday when Piedmont slows its growth and everything catches up, hopefully what we will have is that the captains who have been trained in the leadership program being given feedback about their LOFT scenario by a check airman who in fact knows about the leadership model so that all that will tie together very neatly and tightly.

We see a couple of critical issues in this whole train-the-trainer program. One is what are the trainer's qualifications and what were the selection procedures. And second, trainer burn-out and rotation and how do those things affect the learning of the trainee.

The next aspect is the research piece, and I already mentioned that through the other slide, but our research includes what I'm doing with Clay Foushee of NASA. It also includes the managerial research piece that we are working on. Hopefully, at some point we will have collected enough data in the training program to begin to do some correlation work with the individual's personal score and implications for his leadership style. This obviously will be done with no names on the survey. It will be done either with a mass group of people, or if our approach is to try to correlate those scores with other things then they will be assigned a code number that only the individual knows so that we will not be revealing personal data.

That's the type of research we want to do. At this point we are simply gathering managerial information data from the classes, and we don't have a sufficient log to do anything that's of statistical validity.

The next major thing we are doing is working on the LOFT concept, tying in the train-the-trainer, tying in the information taught in the captains leadership program, putting that all into the LOFT concept so that each time the captain will come through his LOFT exercise he gets the reinforcement of that same information.

The last thing we hope to do is work with flight attendants. The flight attendants are a significant part of aircraft safety and therefore need to communicate well with the cockpit crews. We will also be helping them to maintain their own self-esteem in the face of a cantankerous flight crew or a cantankerous passenger.

Our concept, then, is that if the entire flight crew from the front end to the back end of the airplane has an increased sense of self-esteem that they are going to be a better crew, that the positive sense of self-esteem will reinforce itself in aircraft safety, in the passengers' satisfaction, and in the capacity of the airline to sustain itself at a profitable level. So we teach it both from a safety standpoint and from a managerial standpoint.

Piedmont will begin to offer this program to contract carriers to teach them what it's about. We are also going to be offering train-the-trainer, although the program probably won't be available commercially until perhaps March.

I want to raise a couple of critical questions before we throw it open to questions. These are questions we struggle with, and I thought I'd share them with you for the benefit of the seminar and our group work tomorrow.

The first critical question is how to achieve actual behavior change from a training or LOFT program. We are looking at the need to achieve behavior change, and how do you do that.

The second: Can a LOFT design incorporate skills which will facilitate behavior changes when administered by pilot instructors? If so, how do you train them? They are not psychologists. They are not trained in behavior. What is the methodology in which you train them? I think there are some ways to do that, but I think it will require some very specific instructions and very specific limitations. Is it acceptable to work with feelings during feedback or is cognitive material the only acceptable format? Behavior is feeling oriented. And despite the fact we think we are geniuses, most of our behavior comes out of our gut and not out of our head. So is it appropriate then to deal with feelings, or shall we be cognitively safe?

The next issue: How does the instructor know when the trainee has achieved skills for new behaviors that will demonstrate that he is making a commitment to that behavior?

Next, what methods will best reinforce new behaviors that the pilots learned in the training session, particularly with him sitting in there all by himself flying that airplane when nobody sees him. What's the best method of reinforcement?

Next, how to protect the integrity of the crew member who chooses not to reveal his behavior? I think that's a critical question. We really have to watch that. I recognize a struggle between management and the union and the ineffective captain. I think that there is a whole other level. The integrity of the individual needs to be protected. We are not trained shrinks in the counseling sense. If he doesn't voluntarily come in to deal with that situation, how do we address it? I think there are some very good guidelines that need to be developed around that, strong cooperation between unions and management as to how to deal with the ineffective captain who is flying the airplane.

And at last, the last item: What is management's and the union's responsibility to the public in dealing with crew members who continually demonstrate ineffective cockpit behavior. What are the appropriate evaluative criteria?

DR. LAUBER: Thank you, Hugh and Jim, for giving us that detailed look at the program you have under way at Piedmont. Let's throw the floor open to questions, comments, discussion, whatever. Who would like to start?

MR. FISHER: I'm Bob Fischer of Summit.

There is a thing called Maslow's hierarchy of needs and you folks are operating in the upper realms of that. Do you pay any attention to the lower parts?

MR. HUNTINGTON: Maslow is an old friend. We deal with Maslow in the context of a self-esteem model. I've worked with the Maslow concept for years. If I had the captains for a longer period of time, I would teach them that, and that's maybe what I will add in the half day process that Jim and I have been talking about.

What I found is that the feeling orientation, teaching males to be sensitive to feelings, takes care of the vast majority of Maslow's hierarchy. I taught it for years and found the only way that people ever transferred the learning was when you put it at the feeling level and got it out of the cognitive context.

DR. FOUSHEE: I'd like to ask a quick question here. Hugh, you are obviously dealing a lot on the feeling level. You talked a lot about self-esteem. That's an area, and I think most of the people here would agree, that pilots probably tend to be a little bit uncomfortable with in the beginning. Could you comment on the process that you go through with these people and how that works out?

MR. HUNTINGTON: Yes. It's simple and crude. I begin with the groundwork that says we need to be honest with each other in this class and what comes up in this class is private to this class and will not be repeated outside. And then I ask them if anybody in the group has a problem with that. I begin at that point to demonstrate a process of integrity and honesty, and I will very gently give them feedback about concerns I have about their individual styles.

In the process of dealing with feelings, I make a very brief statement about how we as males, particularly in the Western culture, have been taught not to deal with feelings and that what's happened is we've cut off a real resource to ourselves. Then I start tying in aircraft related data -- accident data -- that says that if the captain had learned to listen and had not been quite so defensive, maybe this wouldn't have happened.

By the process of my individual interaction style and the use of actual aircraft accident data, I demonstrate that we are all vulnerable to not hearing and not managing the total resources.

Then I make it safe for people who want to start talking about feelings and I'll ask them what they feel. And they will typically say, well, I feel like that's a good idea. And I say that's not a feeling, that's a thought. And through that continual sort of bantering and light joking, by the end of the two days they get into some pretty heavy feelings.

It's not a sensitivity lab. That's not the purpose. They start saying, "Yeah, you know, I really do get pretty angry when that co-pilot sits over there and says nothing. I hate a bungling idiot who says nothing to me." And I say, "what is your piece of the responsibility? Let's look at your leadership style." And he shows me a style that's very passive. I say to him "when's the last time you asked your first officer to give you information?" And then I teach him how he can start going about it.

One of the things we do is teach the new captains to prepare a speech for each new first officer they fly with -- and at Piedmont they rotate crews every 30 days or once a month. And what we do is teach them how to make a speech, an introductory speech that I really want you as a resource, and I don't want to drive you away. And if I come on to you too hard, say something to me like hey, wait a minute, I have a thought, or wait a minute, listen to what I have to say first." So we teach the captain how to give the co-pilot permission to be however the co-pilot needs to be to be a maximum resource.

So we do some behavior rehearsal. Clay, that's the way I approach it. It's nothing deep, it's very simple and it's very brief, but I find it to be very potent and very effective.

DR. LAUBER: Did I see a question over here a little earlier?

MR. LAUBER: Chuck Brewer from Summit Airlines. What do you find to be an optimum class size for this type of training? And secondly, the scenarios that you are dealing with, are they from accident reports? Are they from line pilots that have given information to you that are actual Piedmont problems and operational problems? What's your source of scenarios and how do you present them in a class?

MR. HUNTINGTON: The source of scenarios is both from aircraft accidents as well as from testimonials that we've

had of captains on the line that we interviewed. Our cases are written around actual Piedmont examples. We also take things like an aircraft accident and without trying to alter the content -- in fact, what we do is check the content with the management staff to make sure we have maintained the integrity of the content -- we will write a case scenario description around an aircraft accident so that we document it from an elapsed time standpoint. We clean it up from the harsh analytical viewpoint that the typical aircraft accident report goes through. We make it a little more human and real. And that becomes a case.

Your first question addressed optimal size, and frankly, I have not had the option to determine the optimal size in this program, because Piedmont has a very limited reserve staff, and it's all they can do to cut loose six people at one time. I would frankly like to see it at ten to twelve. That gives me much more flexibility with experiential design models, learning games. It gives me much more cross-section of pilots, because in a couple of groups I wound up with so many people that acted so much alike, I couldn't make any interpersonal differentiation. So then I had to make up hypothetical examples to cover people that had already been in the program.

I would much rather be able to contrast Bob and Tom and say let's talk about you two flying together. Bob, you are the captain first. What are those dynamics? And then I switch it. What I demonstrate from that exercise is that when you switch it it's a very different dynamic. So from an optimal six standpoint, I think I'd rather be operating at from ten to twelve.

DR. LAUBER: Any more questions? Okay. Very good. Thanks again to Jim and Hugh.

Once again we're going to switch gears to some extent and take a look at another issue that we wanted to raise for this workshop and to have you deal with during the course of your working group meetings tomorrow.

I know that many of you were in Tampa or at other meetings where you've heard Ed Carroll from United present United's cockpit resource management program. Knowing that was one of the reasons I asked Ed and United to put together the presentation for this conference that rather than take a look specifically at United's cockpit resource management program, we take a broader look at the whole issue of integrated flight crew training as it's been done at United.

Ed Carroll was an Army Air Corps pilot and then joined United in 1946, was promoted to captain in 1956 and entered United Airlines's management in 1961. He became an officer

in the company in 1976 and 1977 was assigned as the vice-president of flight standards and training at Denver.

He's corrected me on the next sentence. Initially he said he flew seven of United's aircraft from the DC8 through the Boeing 747, which doesn't fit with either the year of hire or the seven aircraft. But it is the DC3 through the Boeing 747.

In June of 1982, Ed retired as vice-president of flight standards and training and since that time has been working under contract with United as the program administrator for United's cockpit resource management program.

INTEGRATED APPROACH TO FLIGHT CREW TRAINING

AT UNITED AIRLINES

J.E. Carroll

United Airlines

CAPT. CARROLL: Thank you, John. A couple of things before I get started. One, John did ask me to cover more of a subject than just cockpit resource management. As a result of the previous presentations, I'm having a baby waiting to get to that part of my presentation, because I'd like to address some of the things that they have already covered and to demonstrate that we probably all have a slightly different outlook on some things.

First I am going to take a look at training in general and try and give you some recognition or perspective that perhaps you can use in concert with what you already have. Some of what I'll say I think you'll probably find you can adopt or adapt depending upon your resources and the people with whom you might get together to do that. Again what I guess I am saying is cooperate in getting to your training goals instead of each of you trying to invent the wheel each time.

So as I go through this, the first part of this is a commercial, because we show our training center. But as Paul Caro said this morning, training centers or training tools do not teach. Now, we house everything there in the training center. We have a mission that we have been assigned at the training center to do our training safely, efficiently and legally and to apply some quality control. That's been our approach for quite sometime.

In applying all of the types of training, we try to take an approach that the training should be based upon the same objectives and criteria. That means that you should have a consistent approach in what you do with your people so that when they go from airplane to airplane or seat to seat, the transition for them is facilitated by the fact that the training method is essentially the same.

Our approach as far as training is concerned is to base things primarily on what we call the SAFOT document or a Systems Approach to Flight Operations Training. SBOs is another way of looking at it. At the same time try and take advantage of all the technology in achieving our objectives.

So when we look at our overall training analysis, we do start off with what the objective is for that particular course. We determine what the criteria will be to measure the achievement of those objectives. We decide on the procedures, software and hardware that will be used in the program. We assess the personnel requirements that are contingent upon that assessment. We determine whether the criteria that we had established can be used in other ways from the standpoint of the fallout of the information we get; are they achieving their purpose? And then we have a training and/or evaluation proposal that we will submit at the end of the training.

Basically, to use a phrase that has been used earlier today, we try to approach our training on a need to know rather than a nice to know basis. Paul referred to that this morning. We have had some questions, as he said, about whether the content of our training has been as good as it should have been. Did we have enough nuts and bolts information in there? Jim says his airline is a nuts and bolts airline.

Well, as Paul indicated, we've determined that the content of our training really is enough for the flight crew members to operate from their crew positions. We use the phrase that we "teach from the cockpit out rather than from the system in." What can the pilot do about what is presented to him; how can he address what comes to his attention, rather than get back into the background that so many of us had initially about learning all about generators and electric circuits and Wheatstone bridges, and so on, and what value was that to us or is that to us today? It leads us to something I'll express later on, and that is we're trying to train our people to be more managers today than we are, if you will, stick and rudder men or women.

From the standpoint of what we have developed, I'm not going to go into a lot of detail on equipment or simulators. You know all about them. You know their uses. You know how effective they can be. I'll make a comment or two relative to them. They will do what you want them to do, but you must determine what it is you think you need to have done.

The FAA in their considered wisdom, I think, have put very heavy requirements on the industry from the standpoint of what simulation should achieve. And I think it's safe to say that after some consideration they have backed off a little bit from the stringent demands they made in recognition of actually what is taking place and what we need to know.

If I can use an expression I've used before, too many times in the past when we've tried to assess any training

tool, and I think the simulator is the best example of it, we have said in the case of the simulator it must duplicate the airplane. I think even that phrase was covered a little bit this morning by Paul. I think it's safer to look at it and say you want to replicate the airplane. By duplicating it means you'd have to get that damn thing off the ground, and if you did you wouldn't use a simulator, you'd use an airplane.

So from the standpoint of use of simulators: we have zero aircraft time training in all of our fleets at United now, and we had the first Phase 3, 727 simulator -- Ed Fell was there with the team just before I retired. They are very effective. The simulators do the job.

But some of the things I think that we also should consider, as has been expressed, is part task trainers and so on. When we got into a bind during some years in the late '70s as far as the demands on our training center facilities were concerned, we found we didn't have enough 727 simulator time available for the demands of the company and the crews we had to check out. So we constructed an advanced paper trainer that enabled us to go through a couple of the early periods in the simulator, and found that the transfer of knowledge from this "simulated simulator" was very effective.

It led us to recognize later on that you do not have to go first class in every case in order to get the information across to your people, to find that effective transfer is there. If we can go from zero airplane time in the simulator training program, with the LOFT following the rating ride, then I think we have proved that we can get out in the world and do things with less than the top of the line trainer, which in the past had been the airplane.

We also recognized that success on the airline starts with the selection process. In the past what we have done as an industry is hire people, put them in the cockpit of an airplane and really say from that point on "you can handle anything." We decided that as a result of what we used as an assessment tool, that regardless of what we do to the airplane, how we advance the technology, how we change the size of the crew, the complexity of the traffic system, whatever, "you can cope." I think that's fallacious reasoning.

As a result, as we got into our last new hire wave in the late 70's, we did a little bit of analysis of what we thought should be considered as far as selection was concerned. We were also influenced by the fact that we had an EEOC decree which caused us to advertise the fact that we were looking for cockpit crew members and the requirements were for a total of 350 hours and a high school education.

Well, from the standpoint of what the entry level was going to be for our training, it was evident it was going to vary quite a bit, because we had B-52 aircraft commanders coming out of the service, and we had people coming in who wanted to come under those minimum guidelines that we had. So we decided that we would try and take a slightly different approach and consider these points.

One of the points we considered was that probably classroom use was going to be inefficient with this broad background of the people that we had. So the training that we went into in the new hire program became criterion referenced. It was individualized and computer based. And from the standpoint of our assessment, I think it's valid for almost anyone that if you can take the people you have and take advantage of what they have learned in the past, then you are going to be able to effectively show that you've taken advantage of things without having to, if you will, give it to them over again, waste their time.

If we had given the same type of training in the new hire program and put everybody down into one classroom, and they had that broad gamut of exposure that I mentioned before from a 350 hour high school graduate to a B-52 commander who had his own big airplane for a long time and

flown thousands of hours, we'd be over the heads of some and putting others to sleep.

So, as a result, we decided we would go to a computer based training approach primarily to keep the student records; it gave us test scores; it showed us how they were progressing, whether they had to repeat. And we also had as a supportive recognition that they could use the conventional ways of training, which were the slide tapes, the video tapes and manuals that they could go to in case they had problems taking their 20 some tests and courses on the Plato system.

The results of our approach in this regard I thought were rather dramatic. Initially, we scheduled a four-week training course for new hire personnel. In the past we had used three to four weeks and seven instructors. When we went to the approach that I outlined, we came down to an average of nine days to complete and no instructors involved except on what we call a learning center basis where they could call for assistance if they felt that they needed some amplification of what they were doing. In reality, many of them finished in four or five days, but we kept it at two weeks.

This shows the advantages of technology as it can be used depending upon your work load and what your responsibility is to fulfill the mission your company has given you.

Some of the advantages, I think, from the standpoint of going to this approach of computer-based training -- and again I think you can centralize something like this with your people at some one location to where you could come, perhaps, for this kind of thing and minimize manpower demands -- pass exactly the same questions with a correct response. There was no longer any question, as when they sat in the classroom, whether they had all gotten the information.

We had an ability to collect all the data. We were able to change the course material just through programming. Obvious cost saving came into effect. The trainees accepted it very well, and the FAA also gave their approval.

One of the things again that I think enhanced this was that rather than just being in a passive mode of what I call a "pray and spray approach", where you sit them all down in the classroom and spray them with the information and pray that it takes, they now got immediate feedback about whether they knew what it was they were supposed to know.

Touch screen is an example of the response that Paul

pursued this morning and one of the enhancements that we had. They got immediate reaction when they were doing something, rather than just trying to visualize or verbalize what they were doing.

As a result of this experience and recognition that we had, we applied it then subsequently to our initial first officer and initial captain courses, with essentially the same kind of results. From the standpoint of initial first officers, people going from second officer to first officer for the first time, we had these results of ten days coming down to five and two instructors coming down to zero for the same reasons I enumerated before. And from the standpoint of initial captain results, from five down to three days and the instructors again from two down to zero. So there were obvious economic advantages, but there were also learning advantages that we found in using a different approach.

The ultimate in what we have arrived at in taking this approach is in the 767 program. We determined as a result of our experience that we would again use the criterion referenced approach. We'd also stay with the individualized approach and again it would be computer based.

This is what we did at the ground school. We used random access slides, audio, micro-Plato and a stand alone Plato. It turned out to be a multimedia program. The SPT, standing for Systems Procedures Trainer, which is an advancement of the Cockpit Procedures Trainer, based on Plato with the random access slides and tapes, the video tapes and manuals and hands-on training if they had to resort to that when they had a problem.

The overall reason for expressing this is that individualized training, I think, provides a much better product at a much lower cost. There is a much better transfer of learning, because you don't have people sitting in a group worried about asking the dumb question. When they do it in an individualized way they find much better assimilation of the information.

The Systems Procedures Trainer has a Plato terminal, and an AV and video projection system. They have backlighted panels so that when they get to the particular part of the cockpit they are talking about, it lights up automatically. They have their own little cubicle. They have their own disks, and they can proceed at their own pace. When they get through with the individualized training, they inform scheduling, and they get put into the simulator phase.

In designing our B-767 program, we used lessons that we had learned when we put Omega and the DC-10 computations all on the computer. The flight management system was used in

conjunction with the Plato system. What we learned in using the DC-10 flight guidance system is that when people went through an airplane with an entirely new concept -- and the flight guidance system in the 10 was new to us at the time -- it usually was a hang-up point in going through the training. It caused a lot of problems.

So when we got to the 767 and the recognition they now were becoming computer operators and programmers, we decided we'd try to give them an opportunity to train before they got into the expensive full-time training vehicle, the simulator, to become acclimated and adept at punching in the CDU what it is they had to do.

Now let me get into what is a concern that has been addressed earlier this afternoon. With all of the advances we've made, with all of the technology that has been improved, with all of the money we have spent on advanced simulation with the selection process that we've gone through -- we still have accidents.

We mentioned earlier this morning and this afternoon why we address the cockpit resource management area.

We on United had three accidents all in the month of December in the years of '72, '77 and '78. So we decided we had to address a problem.

Let me run through a list of accidents that I've taken from our cockpit resource management program material just to have you recognize the universality of what I'm talking about. The problem is not peculiar to one airline. It is not peculiar to the size of the airline. It's not peculiar to the equipment or the geographic location.

I'm not going to make comments on each of these accidents. It is not my intent to castigate any one particular airline. I've already confessed to three of our own. You'll see eight more from eight different airlines, and I think you are familiar with most of these. They all come down to exactly the same thing, improper use of the resources available to the captain either within or outside the cockpit. Some of these as I say you may be more familiar with than others depending upon your background.

This accident involved an extraneous conversation about an amusement park and busting altitudes going past the final fix too fast, etc. This one I think you are familiar with in the Washington area when they came down to an altitude that was below what they should have been at the time for the distance they were from the airport. The second officer turned off the ground proximity warning, and they hit the water.

This was alluded to before about getting even, by Hugh. If the captain comes on too strong and he suppresses his co-pilot, the co-pilot may not hold a grudge, but he's going to get even. This was a case of the co-pilot getting even, I think, from what we are able to determine. And as a result, he got killed getting even. They lined up with the wrong runway, but he withholds the information from the standpoint of really not coming on very strongly with it, in an assertive manner, if you will.

This one is a DC-10 programmed to climb out on a flight guidance system at a rate climb out. They started to get a burble on the climb out. They think it's one of the engines, and they throttled back. The airplane falls off on the wing and loses many thousands of feet. They pull out, and they proceed on to Mexico City. When they get there they find that they are missing four feet of their horizontal stabilizer from each side. The burble was a stall because they climbed out on a rate, and they were getting to an altitude where they couldn't maintain the rate, and they stalled out.

You are familiar with this one? No comment perhaps in this regard is necessary. But all of these for us, and I think for all of you who have approached cockpit resource management, raised a particular question. Simply stated: Why?

In running through another series that I'll just let you read, I think you'll recognize the approach that we've taken, and then I'll discuss our program just a little.

When we had the history that we did, and we investigated the same statistics that have been reviewed in part today, we discovered that 60 percent of all accidents between 1970 and 1980 in the commercial industry had as a cause, or one of the causes, improper management of the resources available to the cockpit.

What we had been doing paralleled a little of what you heard in part today. We were giving what we call an executive offices seminar to all of our new captains. That was to do what had been outlined here today in part, and that was to educate them on the company, how to work with other departments, the responsibilities of the other departments. It lasted five days. But when we investigated after finding out the need for this training, we also discovered that around the world most people were doing essentially what we had done in the past.

There were several things that stood out for us like sore thumbs.

First of all the accidents that we reviewed were a result of too few questions being asked by the crew, individually and collectively; too little information being exchanged; conflicts not being resolved during emergencies, conflicts from the standpoint of a difference of opinion or reactions that they were getting from their equipment which were different than what they thought they should get, because of the actions that they had taken.

When we looked at all that and looked at all the programs, we found that most people were training only one person in the cockpit, and in the main the captain, and again, mostly new captains. Secondly, they only did it once. And again to use the same phrase I used before, we thought that was a spray and pray approach. You don't keep your handicap down playing golf, you don't keep your tennis game sharp, you don't keep anything going efficiently unless you do it consistently. So we found those two to be rather common ingredients.

Also a third aspect was that most of the programs were relatively passive; they were not participative courses. The individuals again were told what to look for, told what to consider, told what perhaps in a teach or tell way was the way in which they might react or consider reactions. But they never were really able to discern for themselves and internalize what we thought was necessary.

After the '79 seminar that was referred to earlier, we went into action. From February of '79 until June of '79 we had just the management group together, and we really didn't know which way to head. We didn't know whether we should teach command. We didn't know whether we should teach leadership or whether we should pursue resource management. We ultimately decided on the latter, resource management. Command, leadership and resource management were the original considerations and is how we came up with the acronym CLR for the company. In our commercial application of it we called it CRM for cockpit resource management.

At any rate, when we made these decisions as to which way we would go, we felt that we had to have a participative course so that people would be able to have an adult learning experience that was self-convincing. Pilots, if anything, become very resistant at being told what they should do, when they should do it and how they should do it if it is not procedurally oriented. If you try to get inside of their heads, they become very resistant.

We, too, got our population on board. After the first five months when we decided finally where we would like to head, we brought ALPA in in every working group, every committee we had including the steering committee. And that

proved beneficial. We also got their participation in all parts of the program when we put it into effect as a seminar.

Our first approach was to get the word out in a self-study way. Then we put all of our people through a seminar. And we started, apropos of what some other people said, with the top. Our senior vice-president of flight operations was in the first class. We trained all of our management and instructor personnel first. Then we trained all on a peer basis of captains, first officers and second officers.

We used line pilots as the instructors (only we called them administrators). No people from outside the company were used. We had two in each of the seminars. One was a representative of management and the other was the representative of the line. We felt that created credibility and got a lot of response from the crews, and it worked very effectively.

From the standpoint of participation, we had over 100 volunteers from the line pilots to do seminar training.

The seminar training is an opportunity after reading the self-study material to put into practice the things we told them academically and theoretically.

We clarify theory for them on the first day. The balance of the time it's totally operationally oriented just as the text is, although it is based on an academic theory, grid theory. And we allow them to recognize that it does apply in the operation of a cockpit.

Our results to date have been impressive to us but we have very little empirical evidence. I think Mike Yocum mentioned last night, the only way to measure the effectiveness of any course is with the next accident that you are not going to have. And you'll never know which one that was. So any advance you make in safety is really not going to have a bottom line measurement, from the standpoint of how many dollars you save and how much equipment you save.

What empirical evidence we do have is that after a year and a half of application of the whole program, where 4,586 people went through the training -- all of our cockpit crew members, because we feel they all have to be on the same frequency and understand what the premise is, not just one person in the cockpit knowing -- but after that number of people went through 202 total seminars, our failure rate came down by two-thirds. Now, that in itself is the only thing we can point to statistically.

From the standpoint of other results, we have feedback

from our flight standards instructors, the ones who conduct our LOFT exercise. We have a recurrent application in the LOFT in which we videotape the LOFT, play the film back, and they have a peer discussion on what took place. No evaluation, no records kept on what took place in that area. We'd have hell trying to take that away from them, but we had hell trying to get it put onto practice, because you know what the reaction of pilots happens to be to flight data recorders and cockpit voice recorders, and here we were going to put a camera in the simulator.

But we have reports from all of our flight instructors that say unequivocally that they see an improvement in the interaction of the crew members, a dramatic improvement. The cockpit environment created by the captains is one of openness, soliciting input from others, and that has caused a response from the first and second officers to make their contribution so that all of the information is available and a better decision can be made, and better problem solving as a result of all that interaction.

One of the things again that we addressed is the recognition that human factors is a buzzword subject right now. We look at the comfort of the seats. We even put lambswool in our 767 cockpit seats. You look at the lighting in the cockpit, the manuals, circadian rhythms, black hole effect. You tell them all about these things. But we feel that this particular approach to cockpit resource management enables our crew members to operate more efficiently in an imperfect human factors environment, because they work together. They get more information out of that collective working arrangement than they would from the standpoint of any one individual trying to be the authority in the cockpit.

One component of our seminar takes place in an interactive way using a team concept. Picture six people in one of our seminar teams pursuing some task that they have been given in the seminar. After the first day, it is all operationally based with the one exception when we review a film that is not aviation oriented but it is management style oriented. After this interaction, they end up giving feedback to each other on the third day. They are all peers. They never fly with each other again, probably. They have no threat. We don't keep any records.

We have two requirements: they attend and they participate. The union has agreed to that. It's a one-time experience in their career. They go through very long days, from 8:00 in the morning until 9:30 or 10:00 at night, but they have agreed to it. And the recurrent part of the program has started to show that the initial training was very valuable and is showing results as I mentioned before.

One of the things that we do in that LOFT feedback, as I mentioned to you, is that we show them portions of the videotape that the instructor who was present, just to be a communication interface, believes are germane to their learning experience. He may show them items which are a positive reinforcement. He may show them items that perhaps could have been done slightly better. And he'll start a minute or two before the area in which he thinks the discussion will be productive and then he just stays out of it. They watch it, then he turns it off and they discuss it among themselves as to why it went so well or where it could have been improved. If the conversation is not stimulative enough, he will ask a few questions but never judgmental questions. What do you think was taking place at this time? Who seemed to be making the decisions? Something like that, but no judgmental questions.

There was one other payoff that was never anticipated. We were the first ones to get the once-a-year training approval from the FAA, an exemption to do away with the twice-a-year visit. Our results, only coming back once a year now, have brought our statistical information down to the point where we have two-thirds fewer failures than we had before. The only thing we can attribute it to is the one change we've made.

The FAA said they were looking for four things in the way of training: crew concept training, LOFT, the advanced simulation, and human factors being addressed. When we had this course, we figured we'd have a go at it and ask for the exemption. We got it. It saved us 5,000 man days a year in training, and it had an economic payoff we had never anticipated.

From the standpoint of what we do in our recurrent training now, let me describe our three-day program. All of the requirements that the government lays on, all of the things that the company believes are germane to a good cockpit crew member and a team functioning together. They take some form of classroom training like systems review. It goes through the normal emergency evacuation procedures. They'll get scheduled specific instruction if it is deemed necessary by the instructors as a result of what they see in any part of the three days.

They go through over water ditching, if they are an over water crew. They go through the CLR LOFT exercise that I told you was videotaped in the simulator. They get an additional hour and a half after that LOFT exercise to go through the maneuvers that they will be confronted with on their check and perhaps weren't able to cover in the LOFT period. They have the proficiency check and oral on the third day.

And to prepare for all of this, they do prework in self-study material by bringing some of the completed examinations like the flight operations manual exam when they arrive at the center.

Emergency procedures and systems are exams that they have to take. They have available to them audio-visual material to review the systems before they come out and other self-study they might indulge in such as reviewing their manuals as far as approach procedures and so on is concerned.

We also make available flight safety videotapes. We think that's an inherent part of training to review known incidents and accidents. We go into our own primarily, but if there is one from the rest of the industry that we think is germane to our operation, then we review that as well.

For example, the 747 spool down. That's the one where we had three engines that didn't respond. The 767 low speed idle is the one in which both engines had to be shut down, and so on. Each one of those things educates the people in the field as a result of putting the tape in the domicile that they can be reviewed.

Overall, as a conclusion I would say that any program that you enter into should have consistency. I mentioned before the ease of going from one to the other. It should give you a promise of return, economic as well as proficiency in training. You should have some form of quality control in your training.

And from the standpoint of the cockpit resource management training, I have come to believe it's the cement that holds all the rest of it together. We can be just so good in our cognitive skills. We take it for granted that the psychomotor skills are there, that they are professional airmen, that they are healthy and mentally well-adjusted when they come to the cockpit. We don't delve into any of those areas, but we try to let them know that if they manage their operation better, if they work together better as a group, as a crew, they will get a much better result.

We are incorporating resource management training in our route checking, our initial operating experience as far as the check airmen are concerned in how they assess what's taking place. Our new hire/recallees are going through that kind of training. (It's an interesting combination to have over age 60 people in the same group with the new hire recallees whom they've been keeping out of the cockpit.)

It still seems to be very effective and taking very well. And we have an intention to go ahead with a variation

of the training in the initial first officer and captain training so that they will now learn new areas of responsibility as it involves cockpit resource management.

Whether you agree with our approach, Piedmont's, USAir's, or anybody else who has an approach in this area is not the question. We all would like to believe, because of the not invented here syndrome, that ours is the best program. But whatever you do, address the problem, because that's where our problems are today - resource management in the cockpit. Thank you.

DR. LAUBER: Thank you, Ed, for another outstanding presentation.

Could we have lights up, please? And open the floor for discussion questions. Jack Enders has one over here.

MR. ENDERS: I'm Jack Enders. Flight Safety Foundation.

Ed, when you have the crew go through the over water ditching and the emergency evacuation training, do you integrate the cockpit and the cabin crew members together on that phase?

CAPT. CARROLL: Yes and no. We have combination classes in some of them but not in all of them. One of the things from the standpoint of integration of the cabin attendants or the flight attendants, as you mentioned, other people have indicated that they want -- Piedmont specifically -- to go after the flight attendants and get them involved in this kind of training. We believe it's an absolute necessity as well. We've got over 8,000 at this point, though, and to try and address a population of that size, the company has not found it feasible to get into it.

But we believe that it should be an integrated approach in every form of training because there is no question they are an integral part of the safety of the airplane when you get into those situations.

DR. LAUBER: Dick Norman and then Ed Fell.

CAPT. NORMAN: I have a comment and a question, too, Ed. I've been through your program partially, not being able to spend the entire time there. It's heartily recommended; it's very good. I'm trying to remember in my own mind, incapacitation training, is that given at that time or at some point of that period of time?

CAPT. CARROLL: We have built into our scenarios the incapacitation training to where one of the crew members will be told prior to the flight that at such and such a

point he is supposed to become incapacitated to see how the rest of the crew will then function. We've had the two-communication rule for a long, long time. We've had films on it that other people in the industry have used, which you are probably familiar with. But it is an integral part of the LOFT training, not a separate training vehicle.

MR. FELL: Ed Fell; FAA. Do you have several CLR training courses developed so that when a guy comes back for his next recurrent a year later he doesn't get the same course or something different, or how is that set up?

CAPT. CARROLL: That's a good question. Yes, we do change it yearly. No one goes through the same thing twice, either in the LOFT scenario or in the associated cockpit resource management information.

As an example, in the first year we used a film of an accident, which we use in the commercial version of this training, the Ketchikan accident. We asked the individuals the first day they were there, as a preparation for the next day when they are going to be involved in the simulator themselves, on a nonthreatening basis to assess what they believe was taking place in that particular cockpit. We filmed a re-creation of it in our cockpit, one of the 727 simulators. They get an exercise to assess that sort of thing. This year we've taken that out and substituted other materials which they respond to even more than they had to the Ketchikan.

One of the things I can say with confidence, that anyone who gets involved in one of these programs -- and I think I've heard the same thing from others -- the deeper you get into it the more you become committed to it, because you recognize the efficacy of what it is we are pursuing.

As I mentioned, we have a commercial version of this thing now. We had no intention of going commercial with it, but because of the questions we were asked, we've gone into it. We have run ten seminars commercially now. There are some people in this group who have attended some of those seminars. So far, the total has been 246 people that have gone through it.

We have an assessment, just as the other people have indicated, a critique of all of our training programs. Every time somebody finishes the training program they turn in a critique sheet and we try to learn from those critiques in all of the programs. We have a specific one for the cockpit resource management. On a scale of one to nine that we use the captains had rated it at 6.9, the first officers at 7, and the second officers at 7.1. In the ten commercial ones we've run, they've averaged out to 7.7 and have gone as high

as 8.7.

I think there is a reaction to the need for this kind of a program, and I think that again whatever you do, you address the program. Don't just figure it's going to go away, because we are all the same fraternity, have the same problems, and we all have to address it in some way to preclude having those problems continue.

DR. LAUBER: Other questions? Okay. Very good. Thank you, Ed.

Ed was concerned there was a bit too much overlap between the previous presentations and his own. To the extent that each of the programs that you heard discussed today share common elements, that's true. I think all of us saw some of the commonalities in the three programs, but we also noticed distinct differences.

I made the comment earlier today that I'm not so sure that there is one best way to approach the issues that we are trying to deal with, and that was one of the reasons that I was not concerned terribly about overlap in the three presentations, because there are different ways of approaching them. I think we are still learning how to use these techniques and what works and what doesn't. So I am encouraged to see the kind of diversity and at the same time the amount of commonality that is present in the programs that we've seen discussed today.

There was another reason for wanting Ed to expand his discussion beyond the CLR program. And that's to tie this whole discussion of cockpit resource management back to several of the key issues that Paul Caro raised in his paper this morning. There were several important themes that Paul raised in his paper, but I think one of the most important points was that any training program for flight crew members has to be based on a consideration of what the requirements are. We have to understand the objectives.

We've referred to it as ISD, specific behavioral objectives and so on and so forth, and I want to tie all of these together, because there is a bit of a tendency to compartmentalize. It's easy to think about technical training programs and computer-based training programs and cockpit resource management training programs and self-esteem models, and to compartmentalize these and not really think about all of these things as being elements of a training program which is trying to turn out a trained individual, who is trained to the exact specifications and requirements based on our best understanding of those requirements determined by the equipment and the environment in which those people operate.

So keep in mind that in all of this we have to understand what the requirements are, based on what's driving it, the system, the environment, the equipment, the people that you put into the training system and that these are all elements of one training program. They are not a collection, a haphazard collection of training programs that address piecemeal various elements. It has to be an integrated approach in the long run and that was one of the reasons we wanted specifically to explore that.

With that it's time for the break. And then when we come back we are going to hear some reports from various individuals of the RAA training and operations committee who have been working in the past several months on various approaches.

RAA COCKPIT RESOURCE MANAGEMENT COMMITTEE REPORTS

OVERVIEW

Richard L. Collie

Regional Airline Association

MR. COLLIE: Last November at the Regional Airline Association convention in San Francisco, we had an Operations Committee meeting, which was subsequent to John's presentation of cockpit resource management at our Operation seminar in Tampa, Florida. The Regional Airline Association at that time realized that they must get into the cockpit resource management arena and do what they could to adapt the principles that were already in effect by the large major air carriers to the small regional and commuter air carriers in the United States, who have limited resources, limited manpower, limited training aids and no simulators. In fact, there are only two approved simulators in the United States that can be used by commuter and regional airlines. One is the Convair 580 simulator, if you can call it a simulator, in Denver, Colorado. And the other is the Swearingen Metro Flight Safety simulator in San Antonio, Texas.

So the problem is a little different. The problem is how we can adapt these procedures, this training, so that we don't have to plow the same ground over again, and so we don't make the same mistakes everyone else has made.

Al Stephens and I met with Al Chambers and John Lauber and suggested that maybe we could sponsor a workshop together and hopefully we would be able to get information that could be presented at this workshop from a committee of regional airlines that would implement certain cockpit resource management techniques in the intervening period.

As a result, we formed a cockpit resource management training committee that consisted of Pennsylvania airlines, Ransome Airlines, Mississippi Valley Airlines, Metro Airline, Air Midwest, Scenic Airlines, Air Wisconsin, and Midstate Airline.

We wanted Scenic to participate because they fly airplanes with single-pilot crew. Single pilot crewing is one thing that hasn't been discussed today. I hope USAir and Piedmont representatives can discuss this during the question and answer session.

We have a lot of single pilot operations. PBA, for instance, has 37 Cessna 402's that they fly single pilot. There is a different problem with cockpit resource management in a single pilot type operation.

The committee met with John Lauber and other NASA people here at NASA-Ames in early January for a couple of days. We subsequently went out to Denver as a guest of United Airlines for a two-and-a-half day meeting. Later we sent two of our committee members through the United seminar.

Along the way we agreed that we would try to divide up different CRM techniques and let each airline take and look at a particular technique of implementing cockpit resource management within their airline and to come to this workshop and have a show and tell of what happened. Was it successful? Did we accomplish anything?

We had a lot of great plans, but like all great plans a lot of them fell by the wayside. We didn't get to do all the things we wanted to. We wanted a statistical base of some kind so that we could see what we had accomplished.

So, we ran into some obstacles, but the airlines that did implement these programs are here today to share with us their experiences, how they went about it, the successes that they've seen so far.

Two of our speakers who are listed on the program are not here today: Captain Hans Rassmussen, Midstate Airlines and Captain Randy Rogers of Mississippi Valley Airlines. We are sorry they could not be here.

Today we will hear from airlines that used paper awareness methods only, airlines that used video techniques, and airlines that used simplified scenarios. When I say simplified scenarios, that's a couple of chairs and some training aids. We have one airline that used a generic training device that very closely represents a Cessna 402 aircraft.

We wanted to consider using a static airplane. We also wanted to think about using the airplane itself for LOFT scenarios. Is it feasible?

We will start with Captain Mike Yocum, Vice-President of Operation for Pennsylvania Airlines. Mike has an outstanding training program. His airline is one of the Allegheny commuters and his training staff does an excellent job of using video concepts. Mike will give us some insight into his cockpit resource management program using video techniques.

VIDEO CONCEPTS IN CRM TRAINING

Mike Yocum

Pennsylvania Airlines

CAPT. YOCUM: Thank you, Dick. It's a pleasure to be here today. And it's a little bit difficult to follow in the steps of the big guns of our big brethren major airlines. I don't claim to be an expert in the field of cockpit resource management, and what we've done basically is experiment without trying to teach anything for the last year. I'd like to thank you for the opportunity to share these experiences with you.

The topic that I agreed to take on was video concepts in training applications. And I can't really tell you just about that, because it's just the medium that we used. I really have to start at the beginning and tell you a little bit about what we've done for the last ten months. And I hope I don't steal anyone else's thunder in the process. Dick has already told you about the committee work, and this afforded me personally the exposure to think in terms of what it is that we needed to achieve.

I had the opportunity and privilege to attend United's cockpit resource management program which Ed so expertly administers. And more recently I had the privilege of being hosted by Stan Fickes and Chuck Copeland to experience Dr. Sellard's expert presentation at USAir on captain development.

In-house our preparation for our attempts and endeavors in cockpit resource management began with a program definition of what we wanted to accomplish, and the method of that implementation. And above all, we wanted to create in the pilot group a thirst that they were really eager to hear the subject of cockpit resource management. This was something that wasn't really new to any of us and certainly isn't new to you. It's just redefined. We've put a label on it. And when I first heard John Lauber's presentation down in Tampa, it excited me to put this label on a particular topic and really identify the importance of that topic.

I was extremely privileged to be able to create this same atmosphere with our pilots during March of this year by having John Lauber fly to Harrisburg from San Francisco and Dave Shroyer from United come in from Denver, and Dick came up from Washington.

And along with the support of our company president, Roy Clark, who announced and introduced the program, we put

on a little two-hour meeting that introduced 35 of our pilots, about 12 of our flight attendants about a dozen management people in our company, and some invited guests some of whom are here today, Fred Spatz from Suburban being one of them.

And it gave us the opportunity to expose out pilots firsthand to John's very excellent and provoking speech and United's approach to what they did with command leadership resource management training and for Dick to give an excellent overview of what it is that the Regional Airline Association through the committee and through this conference this week hoped to achieve. This indeed stimulated our people to where they started to become thirsty for what it is we might be able to develop together.

The term "together" is very important here because the next step we took as a follow-through action was to have a meeting with our in-house pilot group called The Pennsylvania Airlines Pilots Association and gain their support and enthusiasm and direct cooperation into the development of our program.

Following that meeting, we also had an instructor workshop in-house where we again took a look at defining the goals of just what it is that we wanted accomplished and how we would go about implementing the program.

The first thing that we did following our inaugural meeting -- which, incidentally, was videotaped, and this afforded all of our pilots to be able to see the entire meeting -- was create a section in our "Pilot Bimonthly."

Let me explain the "Bimonthly." It's actually an adaptation that we stole from our big brother, USAir, of what they call their "Flight Crew Quarterly." We do it on a bimonthly basis; try to do it in short bits and pieces of general subjects and also specific topics for a certain airplane. It's a self-study course, a brief test that's handed out or rather issued with the course and then turned back in at the completion of the month the bimonthly is issued in.

We created a section in the "Bimonthly" for cockpit resource management. And what we've used as material in this bimonthly section has been what I feel are excellent articles from trade magazines and publications so that we can again maintain the awareness of what cockpit resource management is and why it should be important to us.

In March of this year the "Bimonthly" contained a topic called "Cockpit Resource Management" which was an article by Dan Manningham and was published in "Business and Commercial

Aviation" in August of 1982.

The next issue was May of 1983 where we used an FAA accident prevention program publication entitled "Human Behavior, the Number 1 Cause of Accidents."

In July of this year, we had the topic "Cockpit Encounters" which was excerpted from "Psychology Today" magazine from November of 1982 and was written by William Burrows.

These articles indeed enhanced the thirst that we were trying to create in our people and kept the subject in front of them. And we feel that just the awareness itself has been a very important step in the learning process that we hope to build on in the future.

The next step we took was with our line supervisory pilots, and we had several meetings with them where I explained all the happenings within the Regional Airline Association committee. We talked about what we'd like to do and how best to go about that. And they agreed to take on the task of examining the manuals and procedures and the cockpit duties to examine the CRM techniques that we were currently employing and evaluate where we really stand; what changes do we need to make; what improvements or additions or deletions. Really just take a look at what we are doing now and determine a base from where we need to make any changes.

Getting to the subject of video techniques, the training department delved into the creation of video programs. And initially it was a very difficult chore. I have two of my experts here with me today: Stan Czarnik, who is one of our captains, and Dick Stonefeld, another one of our captains and check airmen. These gentlemen got very excited about video applications to the point now where they have attended a seminar that is specifically aimed at producing video publications on a very inexpensive budget. They just completed that two weeks ago.

The first course they put together or production, if you will, is an introduction to cockpit resource management. It was originally done as a slide tape presentation and then converted to video tape which is a little bit easier format to use, for us at least.

We also had an incident in which Stan Czarnik was personally involved, and he thought it would make an excellent scenario. Stan had taken off from Harrisburg, and shortly after takeoff turned on the engine bleeds, and not too long after that they had smoke in the cockpit; he recognized it was probably from the bleed air. He and his

co-pilot had committed a few errors, and there were definitely some communication problems that ensued in this event.

So Stan set to work along with Dick to recreate this particular incident. We have used that film in our training programs to show to a class and then have a discussion among the class as to what they observed, what their actions might have been. We don't do it in a judgmental way, and it's not done in a instructional way. It's done as a learning experience and something that's very thought provoking.

We also experimented with videotaping demonstrations and drills. We were very fortunate in our ongoing transition to Shorts 360s that Craig Horst and company from Suburban Airlines allowed us to go to their facility. And Fred Spatz and his people worked with us to videotape their emergency procedures drills on the Shorts 360. Those turned out very well and have given us additional ideas as to how we can create demonstrations and scenarios on videotape that can be very educational for people to go into that type of training having a much clearer understanding of what it is they will be exposed to and enhancing the educational process.

The additional activity that we've had in the CRM area is that we've been working with an industrial psychologist, who is a professor at Penn State University, by the name of Dr. Rhube Chisholm. He has agreed to work with our company on the grassroots level with our pilots and flight attendants to take a look at defining what it is we need to do and how best to do it. I look at this as being the ingredient to solve the psychological area that we have no expertise in, that being the human behavior element. We are like ducks out of water in that particular subject whereas this is where he works and lives every day. So we are pretty excited about the opportunity there.

To summarize where we think we are and what we think we are going to be doing in the future, we'll definitely be expanding our videotape techniques to enhance the presentation of these programs. But I've defined a new objective to the cockpit resource management training that will in effect only by using CRM as a vehicle to now reach this more important objective in my mind -- if you can say that anything is more important than safety in the aircraft, which of course it can't be.

But the new definition that I've uncovered in the process of our exploration into cockpit resource management is the effect that this entire process has had on our employees and the employee relations that we are starting to enjoy as a result of this project. And it in fact is becoming the saleable product that I can use with top

management to convince them that the expenditure of money is a good investment in cockpit resource management, because it is definitely showing signs of improved employee relations and improved enthusiasm with the employees for the company.

In closing for videotape applications -- which is what I probably should have talked a lot more about and will certainly in our working group be able to give more firsthand information, in fact, we brought the tapes along -- my conclusion is that in videotape applications with simple home videotape equipment you can do some pretty impressive productions on a beer budget. Thank you.

MR. COLLIE: Mike, thank you for sharing with us those experiences. Are there any questions for Mike? Does anyone have any questions on techniques or on anything?

I guess you get off easy, then, Mike. Thank you kindly.

Captain Frank Foster, the chief pilot of Ransome Airlines was fortunate also because Ransome also has some pretty sophisticated video techniques and video equipment. I guess Dawson has purchased some of that stuff, and they have made quite a bit of use of it. In fact, Ransome filmed John Lauber's presentation the day following his presentation at Pennsylvania Airlines, and I have back in the office at home copies of that video presentation which is a 60-minute presentation for all of the committee members on CRM and RAA. I also have a Beta and a VHS copy of that in a lending library, which I will be happy to lend to any members of the RAA if you want to show that to your people or if you want to get it and copy it, as long as I get the original back.

We were very fortunate that Dawson and his people and Frank Foster provided that service for us. Frank has some ideas on video concepts, too. So without any further ado, Captain Frank Foster of Ransome Airlines.

Frank Foster

Ransome Airlines

CAPT.FOSTER: Thank you, Dick. I was hoping that Mike would cover everything that I had to say so I could say we did just what he did and go back and sit down. However, it didn't quite happen that way.

We were exposed and educated in cockpit resource management about the same time most of the members of the RAA were with Dr. Lauber's presentation last November. And we realized at that time that we were very proud of ourselves for our technical expertise in how we run our airplanes and how we teach our airplanes. But we realized after his presentation that we didn't really train captains; we trained pilots. We taught pilots and we instructed in equipment. John's presentation, for those of you who have seen it, delves more into a captain being a captain, not a pilot with four stripes.

We realized, as the Association did, that not only were we lacking there, we didn't have anything. When we at Ransome upgraded a pilot to a captain's position, he would get an hour in my office sitting across the desk drinking a cup of coffee with my "now you are a captain" speech. And compared to Dr. Lauber's presentation or United's \$7 million program, mine was definitely on a beer budget, one cup of coffee.

After going to John's presentation, we decided, Mike and I, to get John to come to Philadelphia and give that presentation to a limited number of our pilots. We limited the number so we could tape it, and we have presented that tape to everybody that has gone through recurrent training since then.

We also found when we sat down with the training staff at Ransome, there was no way you could do this with just a video presentation. You had to give background information. You had to give some printed material. As Mike has pointed out, there have been some excellent articles published in trade magazines in the last year. And we have stolen just about as many of them as he has and published them in our "Training Quarterly."

Everybody that used to work for USAir has some type of quarterly. Mine started with "Foster's Quarterly," and then

it went to "Foster's Chronicle," because the secretary wouldn't put "quarterly" in there when it came out every five months instead of every three months. Then it went to "Foster's Semiannual," and then it went to "Foster's Whenever." So now the training department does it, and they do it on a quarterly basis.

But we did the same thing. We stole articles that related to cockpit resource management. The best one that we had seen and that we presented first was an article published in "Business and Commercial Aviation," and it is titled "Why the Airlines are Taking the Macho Out of Their Men." We used this as a predecessor to our own presentation.

The first thing we did after that was to show our recurrent classes the tape of John Lauber's presentation. We used classroom instruction on the management grid styles that we stole from United when we went out there for their presentation.

In the small companies, in the regional airlines, the captain has a lot more leeway and a lot more responsibility and a lot more instantaneous authority, I think, than those who work for USAir or United. So the 9.1-type captain or the very left side of his brain type captain is very prevalent in our industry. Fortunately, there is only one chief pilot in each company. But the 9.9-type approach, the very, very dominant, the very authoritarian captain, is the norm for us rather than the exception. These are the people that we have to try and reach. Whether or not we are going to change their behavioral patterns is another question. Whether or not we expose them to the information and expose them to the education, is our main responsibility, and that's where we are now.

We also have in our classroom presentation a blurb on effective communications in the cockpit. And this is far from the right side; tactful talking; and for the left side; intelligent listening. I think anybody who has been in a small airplane after nine or ten hours can understand that sometimes tactful talking is a little difficult to come by, and intelligent listening is sometimes more difficult to come by. But we do that, and we try to express to the pilots the importance of that particular area of cockpit resource management.

After that, we have an open discussion of the grid styles and their various applications. The idea that the authoritarian captain is not good for all the time, is not accurate, for there very well may be that time where the authoritarian approach is required. So we try and tell the pilots that the styles are different. They have different

applications. If you use a particular style all the time, you will be right sometimes. If you use different types of management styles for different situations, you will probably be right more often. So the lions of the left seat that occupy the seats of regional airline airplanes or commuter airplanes or the single pilot airplanes, are probably not going to change too much. But if you expose them to this, that's the best we can do for the time.

The second phase of our resource training is where the video concepts come in. And what we have done is to take a couple of instructor pilots and put them in a role playing situation, and videotape this. We put it in an airplane in the hangar. We white out the windshield, and we stick Cary Ransome in the back with his multimillion dollar camera. I don't know how much one of those video recorder cameras cost, but it's not really that expensive. United has spent \$7 million, I understand, on their program. So far I have spent 400 bucks on ours. We also haven't run 5,000 pilots through it, either.

We put the instructor pilots into a role playing situation, and we have a training scenario of an incident that either happened in our company or in our community. It's very easy to point your finger at the major accidents that cause zillions of lives and zillions of dollars and say, see, that can happen to you. But it doesn't really make the point to the pilot that you are trying to hit unless you tell him that this happened right here. This is an incident that we at Ransome Airlines were lucky enough to get through. And that makes a real impression, especially when they know who did it.

The next thing that we went into when we started this was how are we going to write this? How are we going to put this together to make it not only believable but factual? So I went back to a couple of the pilots who had a very recent incident in one of our airplanes. It was about a year old. And I asked the captain to write verbatim what he could remember of the conversation with the first officer in the incident. And I asked the first officer to do the same thing.

In this incident we had an airplane that lost one of the navigation systems at an outlying station, and its next landing was to be at a maintenance facility. The weather was marginal VFR, but the airplane, according to the MEL, could proceed in VMC conditions with one Nav system.

Enroute the captain had the brilliant idea that he was going to swap the black boxes in flight and assist the maintenance department in trouble shooting the system.

The first officer was a captain downgraded because the PATCO deal, went ballistic, which was appropriate. But his intelligent and tactful talking failed him. And then the intelligent listening of the captain failed him. And then the dominant style of the regional airline captain came out and told him in no uncertain terms where to stick his opinion.

This proceeded to the point that when they changed black boxes, nobody got zapped, and we didn't zap the other system. The airplane made an uneventful landing at the maintenance facility, had both systems fixed and proceeded for the rest of the trip that day.

Needless to say, the next day said first officer was in my office complaining about said captain, and it proceeded to be a rather interesting discussion.

That, to me, was the most effective scenario that we could come up with. Not that it's the only incident that we've had in the recent past, but that it was one of the best examples of a failure of all of this, and it really, really hits home.

And what was said to them, the captain, who is normally a very levelheaded, bottom line, we will do it together type of individual, excellent aviator, and becoming an excellent manager, wrote that this very oppressive first officer with his very untactful delivery told him in no uncertain terms that he couldn't do that, in an airplane with him in it. Well, he did it anyway.

And then the first officer wrote that he very tactfully told the captain that he didn't think that he should do that, and the captain just unloaded a big 9.1 approach on him and said I'm going to do it anyway, you dummy. Just sit there and watch.

After I had the two transcripts, I had the problem of how do I write this so it's real? Because I have one guy telling me that he said this, the other one said that. So we sat down with the instructor pilots and made it out that the first officer said it less than tactfully, and that the captain accepted it less than tactfully, and that he told him less than tactfully that he was going to do it anyway. And it seems to have gone over very well.

We filmed this training scenario -- we haven't played it yet in the classroom. I'm anxious to do that. We have another class in December and we will play it for them. I am anxious to see the results of the discussion after we play this scenario.

That's where we are right now with it, and that's where we have gotten into video concepts with it. Like I said, you can't do just that. The awareness that has been running through the classroom instruction so far has given us the best results. We get a lot of discussion items out of the people who are in the class. We mix the classes. They are both captains and first officers.

And since we still have captains who were downgraded in '81 because of the PATCO deal flying in the right seat, we find it's very interesting to get comments from them on communications in the cockpit. And I think that that is as important in the overall picture of this thing as anything else that we can present.

These training scenarios seem to be the next step for us, and hopefully we will continue to improve them. Unfortunately, I don't think we will ever run out of Ransome Airline incidents so that we have to go out and use other ones. Thank you.

MR. COLLIE: Thank you, Frank. I have one question. Did you run into any problems in the classroom when you were talking about communications and you had both the captains and the first officers in the same classroom?

CAPT. FOSTER: No, we didn't really, because it's during a normal recurrent training class that we give this presentation. It's very easy to have that happen. It's very easy for that class of three very dominant captains and two or three not quite so dominant first officers to keep the first officers quiet. But that's relatively easy to handle, because I can usually pick on one of the captains and get a response. And normally I can pick on a first officer and get a response back from them too. It's not so hard to get them to talk about it as it is to get them to realize why they didn't want to talk about it in the beginning. But once you get the ball rolling, it pretty much goes right on.

We have one extremely dominant lion from the left seat, and he will just about stifle any class, but, fortunately, I give the cockpit resource management presentation, so he can only stifle the class up to here. So that's about the only time I had a problem.

It's not a big deal, I don't think, with the first officers in the classroom environment, and it is a little easier for them to express themselves there especially if I'm sitting in the front of the class. If you have a strong instructor, I think he can counterbalance the strong captain against the first officer position.

MR. COLLIE: Any additional questions?

CAPT. FISHER: I'm Bob Fischer of Summit.

One of the keys to establishing credibility in a program such as you are describing is to have the full support of your instructors. How do you then select your instructors? Do you have a common criterion that you find is most important, and how did you go about convincing your instructors to support this program?

CAPT. FOSTER: There are two questions there really. Let me answer the second one first. Convincing the instructor pilots to get themselves involved in this program was not very difficult. All the instructor pilots were present for John Lauber's presentation at Ransome. All the instructor pilots knew we were involved in it and had some background prior to John coming. All of the instructors were involved in the question of how are we going to effectively put this across to the pilots? We have a monthly instructors' meeting, and this was the topic for three months prior to John coming. So they had a pretty good background by the time he got there.

So the instructor cooperation was 100 percent just from knowing that the company was behind it, that we were very interested in this portion of training. These are the guys that pride themselves in their technical expertise and their ability to get things across to the rest of the pilots. And I don't think anybody will question that they do a good job. I think those guys are dynamite. They keep 103 pilots doing it the same way, which is impossible but they do it anyway.

When we go about selecting instructor pilots, the one thing we don't use is seniority. Not to burn anybody up, but we don't use that. That's not a consideration at all. We ask all instructor pilots to give us a list of other people that they think will be good instructors. And the master list of all those people is turned over to the director of training and myself and we review it. We go through backgrounds and education and experience level for those individuals.

The next step is to ask all the instructors to rank the people that they recommended in order. And surprisingly enough, every time we have picked a new instructor, he has been recommended in order by everybody else who has been an instructor, so it makes it easy.

I think I answered the question, so is there anything else?

MR. FELL: Have you had any problems or do you think you might experience any problems from using your own internal incidents involving your own internal crews as examples of how not to do things by showing other crew members here's

what happened to these guys. "They did wrong." "We'd rather you didn't do it this way." Have you experienced any feedback from these people?

CAPT. FOSTER: Surprisingly enough, we haven't yet. When we went about designing the first scenarios, we had a long discussion on that. As a matter of fact, we used up one entire instructor meeting on just where were we going to get the information that we built scenarios from. We had a few examples that we could have very well used that were not in-house incidents.

The prime example was the Swift Airlines crash in Los Angeles where the crew shut down the wrong engine. You can build a very effective training scenario from that particular incident. We discussed that at length, and we have that in the back of our mind that if we run into any reluctance we will go to that type of approach.

What I found is that if we can start the discussion prior to the scenario, prior to the tape, and tell everybody that this is an in-house problem; we had this incident; it was right here; it was by you or your peers; it was by one of us who did it; it's an attention getter from the beginning. How effective it is we haven't been able to measure as yet, because we haven't presented it to a class. But I have presented the same incident, this one, to the pilots that were involved in it, and both of them think it was extremely well done. Whether or not that continues, I don't know. Both of the pilots who were involved in this incident were people you could do this to.

We make them as clean as we can. We don't identify anybody, but anybody who has been around the company knows exactly who did it. So it's not a question that we are telling a story out of school. Everybody already knows it. It's a small community. It's not like United Airlines. If we have an incident of that type, every pilot in the company is going to know it two days later anyhow! So this way we bring it out and say, yes, it did happen here, and we hope everybody learns from it. So far that's the reaction we have had.

Anybody else? Okay. Thank you, Dick.

MR. COLLIE: Frank, thank you.

Frank will be chairing working group number two. Our working group chairman for that particular working group couldn't make it out to the workshop, and Frank very graciously consented to volunteer.

Metro Airlines has for some time been using some

simplified scenarios for cockpit resource management training. They have been very successful in accomplishing it with unsophisticated devices and good simplified scenarios.

Captain Ron Rice was unable to come to the workshop, and Captain Dan Weatherly the chief of training for Metro is here to make the presentation.

USE OF SIMPLIFIED SCENARIOS FOR CRM TRAINING

Dan Weatherly

Metro Airlines

CAPT. WEATHERLY: It's a pleasure to be here today. I was especially pleased to see the aviation university system represented here today, because it is to them we must all look for the solutions to the long-term problems for cockpit resource management.

We were asked a year ago to do a study on the use of simplified scenarios for cockpit resource management training. We did so, and we found out some very interesting things during that study. We started an eight-month test program using a Frasca 102G generic type training device.

The program started in November 1982 and progressed to June 1983. In that time we processed 86 pilots through the program. It required that three coordinators be trained to administer the scenarios.

The coordinators' training consisted of a personal study of the NASA publication, "Guidelines for LOFT". Since it was a generic trainer, we did not want to use a true LOFT scenario. Instead, what we wanted to use was line oriented simulation to increase the realism to the pilots.

After studying the NASA publication, we had several group sessions among the coordinators to talk about what we wanted to accomplish during the study and how we would go about accomplishing those objectives.

Also, there were several practice scenarios conducted with volunteer crews. Once the coordinators' training was completed, we progressed into the actual training programs. We used recurrent flight training for captains to start the program. We asked that the first officers who happened to be flying with the captain that month, also attend the training program, which they did.

The first thing we did was explain the purpose of the testing program and what the line-oriented simulation was all about. What we tried to do was appeal to the competitive spirit of the pilots. We tried to put it in a team concept, appealing to their ability to compete against the airplane and the air traffic control system in weather. And in doing so the pilots were helping us pull the line-oriented

simulation off in that they really tried their best to put themselves in the situation.

The next thing we did was set down the rules for the conduct of the scenarios. We did this by writing them down. For instance, since it's a nonvisual simulator, they had no way of knowing whether they could land out of the approach or not. In that instance, if the pilots got to the MDH or DH, and the coordinator determined that they could land out of the approach, he would say they were visual, and they would land. If not, they would go ahead and make a missed approach.

In addition to that, we gave each crew a packet of information. The trip information consisted of a trip schedule with two flights that they were to complete, area and terminal forecasts, winds aloft forecasts, hourly sequence reports and a section of notams. We used actual weather from days of poor weather that we had in the Houston area. We had them fly routes that they were very familiar with to increase the realism.

In addition, the coordinators also received a trip information packet. In their packet was the purpose of the scenario, weather data, the clearances that were to be given to the crew and the coordinators.

The types of malfunctions that could be given in this generic type device broke down into communications and navigation anomalies, weather anomalies and air traffic control anomalies. We thought that to go into malfunctions that were particular to the type of aircraft or simulator they were flying was going above and beyond what we could realistically do.

The type of training goals that we tried to obtain with the use of these scenarios was to give the crew practical experience in changes to standard clearances, and in operative communications equipment, which we had the most fun with; having a crew take off and lose all communications ability shortly after takeoff. Specifically, as anomalies we used: inoperative navigation equipment, some subtle incapacitation exercises, marginal weather conditions, changing weather conditions and flight delays caused by ATC.

About a month after we started the scenarios, we saw several things happening that we couldn't explain at the time, but through additional experience with the program we were able to formulate some ideas.

The first problem we ran into is that the crews had problems talking about the management aspects of the scenario. There was no common language between the crews to

talk about these things. That led us into doing a survey of all the crews to determine which crew members actually had any type of management training before they became professional pilots. Seventy-eight percent of the pilots that have worked for Metro Airlines have never in their college or professional careers had any experience in management.

This led us to a very important conclusion. And that is, cockpit resource management is an advanced management tool. The pilots of the regionals come from quite diversified backgrounds. A large number come from the military, which made up for most of the 22 percent that had had some management training. Because of their military background, they had training in officer candidate school. The rest of the pilots came up through the civilian ranks, and although a majority of them do have degrees, most of them have not been through any type of management program.

The first conclusion we drew from this information was that in order for the scenarios to be conducted properly there would have to be some type of a formalized ground training program to indoctrinate the pilots into the principles of management, not going directly into cockpit resource management but going into the basics of management, of supervisory skills for example.

This led us to another thought, and that was that most of the first officers that are hired by the major airlines, or second officers as the case may be, come from the regional airlines, corporate flight departments or the military. In any case, they have had previous experience in a crew environment. Our pilots, and as an industry, do not have that benefit. They have never been exposed to the crew concept. For the operators who have just gone to a two pilot operation from a single pilot operation, you know exactly what I am talking about. There is a lot of friction in the cockpits, because of the way in which training is done in the United States, pilots are trained to be a pilot in command not a second pilot.

I think one thing we all might think about in the next couple of days is possibly having some type of training program, formalized training program, for first officers, teaching a first or second officer how to be a subordinate crew member. Throughout his previous training, he has been trained only as a pilot in command.

I think as an industry we can look to the aviation oriented universities in the future to provide this type of training prior to the pilots becoming licensed.

Anyway, the scenarios consisted of two, one-hour

flights. This was done without changing what they actually do on the line. This is due to the short flight segments we conduct. After each one of those scenarios, the crews went into a debriefing. The debriefings were the most important component of the scenarios. In fact, they often lasted over two hours.

The coordinator's purpose was to lead the discussion. He was not to draw any conclusions and tell the pilots "well, you did this right and you did this wrong;" indeed when you get into these areas there is no one right way of doing things. The idea was only to provoke thought among the crew members about different ways of accomplishing the same task.

For instance, if they had problems with the radio communications problem, the coordinator might ask the captain, "What other ways could you have handled the situation;" this started the conversation. And then he would ask the first officer the same types of questions. This got the crew members thinking about alternative ways to accomplish the same goals.

We thought that this training would carry over to line operations. The way we followed up on it was to train the check airmen that were regularly flying in line operations to check. For example, they were to observe the crews and see if the coordination training that we gave them carried over.

The conclusion we came to was that the training did not carry over beyond an appreciable amount of time. This type of training indeed takes a long period of time to effect any change. You can't put a crew member through a two or three day training session, bring him back once a year and expect that to suffice. It won't. The crew members must actively, in day-to-day operations, be involved in this type of self evaluation.

Which brings us to the first point again. If we start with the first officers, training them in the basic principles of management and then as their careers develop, nurture these skills, by the time they get to a position of upgrading to captain they will have much more experience in this area, rather than waiting until it's time for them to upgrade and throwing management at them all at one time.

I think the program, for any of the smaller operators that want to try the same type of program, is well worth the effort. It will enable the pilots to have a better understanding of what goes on within operations, what actually goes into flight standards manuals, what goes into operations manuals. And I think you will find it well worth

the time you put into it. Thank you.

MR. COLLIE: Thank you, Dan. Anyone have any questions?

CAPT. CARROLL: I just need a little clarification from what you had to say. You made, as I understood it, a distinction between line oriented simulation versus LOFT. Would you expand upon how you distinguish between those two?

CAPT. WEATHERLY: Line oriented flight training, we felt, should be conducted in a simulator or in a high level training device that is a replica of the airplane the crews are flying. We have two different types of airplanes that we use the scenarios to train the crews on, and that is the Shorts' 330 and the DeHaviland DHC6. Rather than infringe on the major's lead in LOFT, we felt that with this lower level generic training device we ought to call it line oriented simulation rather than line oriented flight training.

CAPT. CARROLL: Thank you for your support. In what you are doing, I would say that the way you are approaching it is just a rose by another name. I think it is doing exactly what it is you are after and that we are after in the LOFT concept.

CAPT. WEATHERLY: Absolutely. I agree with you.

MR. COLLIE: Any additional questions?

CAPT. BREWER: Chuck Brewer from Summit.

How many manhours do you think it took to develop such a program?

CAPT. WEATHERLY: Just approximating, possibly 160. Most of the time for these scenarios is spent in developing them. If you don't sit down and work out all the bugs beforehand, then the objective of the training is never obtained, because there are so many problems with the scenario.

What we found is once the crews were involved in solving a problem, they'd forget they were in a generic device. We had guys literally sweating in there, and I think that that was mostly due to the temperature in the room, but they did get very involved in the program. The crews said it really opened their eyes to something they had never thought about. And that was the purpose of this test program.

MR. COLLIE: Thank you, Dan.

Air Midwest operates 22 Swearingen airplanes out of Wichita, Kansas. They agreed to look at the communications

factor of CRM for their presentation. Captain Martin Shearer is here today to give us the benefit of what's happened with Air Midwest, Martin.

COMMUNICATIONS SKILLS FOR CRM TRAINING

Martin Shearer

Air Midwest

Our airline has grown tremendously in the last three years. We've gone from some 40 pilots to 125, and 5 Metros to 22. And we have a diverse family of pilots from all parts of the country including five foreign nationals. We are finding that our goals that we are striving for are becoming fuzzy. People are not sure where we are heading. So we try to emphasize the communication aspects. We have a company psychologist, and we hired him because we had problems in other organizations, or other parts of the company; low morale, people not talking, etc. I got permission from the president to go ahead and use him for my CRM program.

We looked around at ways we could implement this. We looked at United's program. That quite frankly was much too expensive for us. At 1,250 bucks a person, we couldn't quite swing that. So we took our psychologist, and we sat down and we tried to come up with things that we wanted to emphasize. And there were many, many areas we could have talked about. But we settled on communication skills, listening, conflict resolution and task orientation.

We have a policy of not paying our pilots for training. They are paid for 83 hours every four weeks, and we consider any training as part of that 83 hours. So I ran up against a problem. I couldn't pay them for this training.

We also fly -- well, over a four week period we give them eight to ten days off, so we're flying them pretty heavy. And this training had to take place during their day off. So to start the program off, before they even came to the classroom I had negative feedback. I could be out boating. I'm not going to come to this crap. That's essentially what they are saying.

To open the meeting, we distributed a questionnaire to try and define what we thought were our problem areas, or how the pilots helped us to define it; how they felt about the company, about other pilots, the station agents, etc. This we analyzed and tried to identify areas that we wanted to emphasize in later programs.

Dr. Dave Dalkey our psychologist from Denver, Colorado, wants to introduce a subject, teach it and then demonstrate

it. So whenever we introduced something new, we'd talk about it, and then he would rely on role playing to act out how this theory or skill should work. I found this, and I think the pilots found it very good, because now they weren't talking about theory. They had something concrete. They had in their mind something to which they could relate.

We also tried to establish or focus on what the pilot did for the company, where he sits, how the company feels about him, how he helps accomplish company goals, reemphasizing company goals, and how he interacts with the other organizations in our airline.

We had the ground rules that you could say any thing you wanted to in this meeting. It never left the room. However, if you want to talk about another pilot you could not mention names. First officers and captains were together.

We reserved a seminar block for each domicile. We have three. And then at the end of the day we did a critique.

Now, to be frank, this first phase, was really a shotgun approach. We didn't really know where we wanted to go or what we wanted to hit. We just had an idea. My first thought was that the pilots weren't going to receive this very well and would be very, very negative. And to my surprise, every pilot I talked to enjoyed the training.

We apparently went in with just enough depth that the guy was anxious. He wanted to learn more. We tried to be nonjudgmental and just present ideas, things that he can use. Actually, we didn't even try to fit this into a flying situation. Everything we taught him we tried to point out that, hey you can use this in your normal everyday life, with your kids, your wife with your friends, whatever. These things apply to everyday life. I think this was the key to getting these guys' interest and keeping their interest, and hopefully they will want to come back for more.

We've had three of these seminars, and we have one more coming up. We aren't shooting for 100 percent attendance; we just can't do it. We've got to have people flying seven days a week, and I just can't force them to come on their days off all that time. So it is not compulsory, but we do recommend they come if they can.

What are we going to do in the future? Now we have this data, and we have a feel for what we want to do. We are going to take our psychologist and put him through a ground training program like a new hire pilot. And we are going to give him a set of headphones, and we are going to let him fly the line. And he's going to listen to our pilots' talk,

see how they operate, see how they are supposed to operate with the other station agents, ATC, etc.

After he has accumulated enough data, and he'll determine how much data is enough, we will start to draw up scenarios. The scenarios will not parallel any accidents either from us or from another carrier. They will be purely fictional scenarios. Each scenario though, we hope, will have an object lesson, teaching or emphasizing a certain skill and not just a shotgun blast. As with other programs, there will be no right, no proper answer, but we want the folks, the pilots, after the scenarios are done to talk about it, to suggest other solutions, to suggest how the scenarios could have gone better.

The scenarios will be done by way of role playing, no procedure trainer. Just two chairs sitting side by side. Keeping it as simple and, well, as low cost as possible. I've been told I can do anything I want as long as it doesn't cost anything. As a commuter airline I know you know where I'm coming from. I could eat up my company's profits in about a year if I really, really went after this, but they aren't going to let me do it, obviously.

Things that we found or that I think that we found, there are a lot of psychologists out there. And psychologists are a lot like pilots. They are different. They have a lot of the same personalities. Every one of them has their own way of doing things. If you do go out to select a psychologist, pick one you can live with. We've had two previous psychologists, and the pilots didn't like them, the company didn't like them, and furthermore, I didn't like them. Dr. Dalkey, however, has a personality, one, that pleased me, and two, he went over well with my pilots rapidly. As you know as we talk we hear ourselves and ask for questions and don't want to raise our hand. That's sort of common. After the first hour or two, I found the psychologist able to draw out my pilots. He was honest with them; told them what he was going to do, and he wasn't going to try to back stab them any way.

Like I said, we didn't start out with any program. We've developed three phases now, or have an outline of three phases. The second phase I told you about were scenarios. The third phase is trying to integrate this resource management into a yearly training situation. And we really haven't figured that out yet. We need more data, and we are really just in the infancy stage right now. I agree with Ed Carroll; it's pretty exciting. And when I can get 125 of my pilots to enjoy something, I think I've got something that's fairly well off.

We didn't emphasize leadership principles, per se. We

talked about communication skills, listening skills, set up conflicts and gave role playing to show how solutions would work. So in a roundabout way we backed over the leadership. During the next phase we will probably address it head on, address leadership styles and refine our program, focus it more towards the cockpit and how it works, how it fits in with the rest of the company.

So we are just beginning. We have a long way to go, but right now we are fairly happy with it.

MR. COLLIE: Thank you, Marty. Any questions?

Marty is going to chair working group number four tomorrow. All of the gentlemen are going to be here for the next couple days, if you have any questions, seek them out and talk to them individually.

Captain Jim Lawver, the chief pilot at Scenic Airlines, has about as difficult a job as anyone. Scenic uses single pilots in their Cessna 402/404's and I don't know how Jim figures out what the pilots are doing.

Scenic is to be commended, because about four years ago they had that accident at Grand Canyon. After that accident they did an enormous amount of training. They have an ATC-810 training device that has been modified to fly like their Cessnas, and they've done a tremendous amount of work training their pilots to fly airplanes that really don't have a lot of takeoff performance.

Scenic agreed to incorporate their dynamic training device in the CRM program. So, Jim, will you tell us how it's working?

DYNAMIC TRAINING DEVICES IN CRM TRAINING

James Lawver

Scenic Airlines

CAPT. LAWVER: Sometimes I feel a little insignificant after talking with many of you out there with big airplanes and large pilot groups. But relatively speaking, even though we are small, it appears we have many of the same problems. I know we are all interested in proving our training effectiveness and insuring that flying safety is as successful as humanly possible.

Just to give you an idea of who we are. I heard somebody on the bus say, "My God, who is that guy?" And what's Scenic Airlines? I didn't know until six years ago either, and if you haven't been to Las Vegas and seen these airplanes with the wild colored tails flying around, you probably wouldn't know.

A year ago at Tampa we indicated that we are a Part 135 commuter operator. We schedule tour flights through the Grand Canyon. That is still true, and we operate out of Las Vegas and the Phoenix area. The only thing that's changed is our equipment and we are progressing -- I think it is progression -- from the Cessna 402s and 404s to Twin Otters, so we are getting a little more involved now in the two pilot versus the single pilot concept, although we are still doing the majority of flying in the 402s and 404s.

Just to give you a little background of what we have out there, this summer during the peak of our season we flew five Titans, down from twelve last year, eleven 402s, and we added our first Twin Otter called the Vistaliner, in July. Our second one comes on the line next month, with the third hopefully early next year. We eventually plan to phase out the Cessna 402s and 404s and have a fleet of modified big windowed Twin Otters. And I'll show you a picture of that in just a minute.

Our pilot force consists of 20 full-time pilots plus five part-time pilots this summer. That's a drop from 30 pilots last year and 50 just two years ago. This season for the first time we did not hire any new pilots, because our recall from furlough was 100 percent. It appears we will furlough at least ten of our full-time pilots in the next two months. Out flight instructor and check airmen status is pretty much the same. By the way, if you are looking for any

sharp 402 and 404 pilots, I've got a few who would like to have some jobs this winter.

We are seasonal, and that's what happens to us. We go hot and heavy from May until October. That's the peak of our season, and then we kind of roll over and die during the winter. So, unfortunately, we hire for that peak and then we have to furlough during the winter months.

We did spend considerable time and effort this year on our Otter training as we geared up for our first aircraft. We are now doing the same thing in anticipation of our second and third aircraft.

The times shown here are just for information purposes and are minimum training times including that in the ATC 810 that Dick mentioned. As you can see, we do use it for initial and recurrent training for the Twin Otter. Obviously, it cannot be counted toward any flight training, but we found it helpful in scan development, overall visualization of position and just basic instrument approach procedures and practice.

For those of you who are unfamiliar with this training device -- do we have any ATC people here today? Oh, yes. Good to see you. The ATC 810 is essentially a cabin class cockpit procedures trainer. The flight parameters, appearance and control feel are that of an 8,000 pound twin for our use. We had it modified for a Cessna 404 Titan.

The instructor panel produces 23 individual system failures, allowing almost any conceivable emergency situation to be simulated. The navigation function is achieved on a 150 square mile navigational area, factory programmed into the trainer. Ours is set up for the Los Angeles area. Normal and emergency procedures can be realistically practiced along with emergency situations of course never practiced in the real world of flight.

Engine sound is an additional element which adds to the realism of the environment. The partially enclosed cockpit includes a pilot seat and a set of rudder pedals with a kick that can produce about 150 pounds of pressure to show what is needed to overcome the yaw on engine failure. That generally gets a new pilot's attention rather quickly.

We also have developed a CRM pilot education safety awareness program plus trying to tie in as much CRM knowledge into our ATC 810 training device as possible. We put together a library of CRM materials, much of it from the good NASA folks here at Ames including the ASRS reporting system, information obtained from the RAA CRM committee and other airline information we have been able to obtain and

additionally a self-study course called Aviation Stress Management for the Professional Pilot. This one is developed by Pentastar Aviation, Inc. a subsidiary of Chrysler Corporation. I'm sure some of you have heard about that.

Our pilot group bought this program on their own. They paid for it out of their own pilots group fund, which was encouraging. They too realize the importance of both cockpit resource management and stress management, both in a single pilot atmosphere and a two man crew environment.

To give you an idea of what is included in that particular program, there are six sequential units to the program, each comprised of a manual workbook and audio cassette tape recording. It is designed as a self learning, self paced program which can be completed almost anywhere. The one unit in there I like especially is called Torque, Pressure, Tension and Strain, which pretty well describes the regional airline management job these days. I guess if you get torqued off enough at your pilots then you can go to this and it will tell you how to relieve your pressure, tension, and strain.

Concerning the ATC 810, we have developed three basic profiles in the LA area: Long Beach, Santa Ana, and LA itself. We try to accomplish as much as possible during each session in addition to the various ILS, VOR, NDB approaches. The training instructor acts as tower, departure and approach control and on occasion as company dispatcher.

We found that the pilots get pretty good as far as basic flying skills are concerned once they master the idiosyncrasies of the trainer. And they generally fly a decent approach with practice. But as the difficulty of the situation increases and they must react to other factors such as changes in weather, diversion airports, equipment failure including engine failure, the training session gets a little more interesting. And you do see varying degrees of overreaction, confusion, mismanagement of available resources as the situation gets more complex.

Of course, in our trainer the pilot is on his own, so he must rely on his own judgment and decision making since there is no crew coordination involved. Delegation of tasks and assignment responsibilities are a one-man effort in this case. We do emphasize using the ground controllers as much as possible to insure the pilot clearly communicates with ATC concerning the seriousness of his problems and in turn clearly understands ATC instructions back to him. We also stress using company dispatch if that will help reduce single pilot workload; in other words, have someone else share the responsibility of problem solving if time and conditions permit. Still very appropriate are such factors

as how the pilot establishes priorities in the cockpit, monitors and cross-checks essential instruments and systems, assesses problems encountered and tries to avoid less critical distractions and problems.

Following successful completion of the three basic profiles I've mentioned, we spend a minimum of two hours in the trainer, both initial and recurrent training, on nothing but takeoff emergencies from the Grand Canyon Airport. We set up the trainer for a high density altitude environment with a field elevation of 6,600 feet, max gross weight at takeoff. And we practice engine cuts on the roll and prior to lift off as well as engine failure after lift off and you are committed to fly. This is repeated until the pilot can correctly recover and maintain all established parameters in approximately 12 seconds.

During initial ground training, we set up different situations that could occur on our Grand Canyon tour. For example, what if certain situations develop? What if the runway is closed at the Grand Canyon Airport? What if fuel problems exist enroute? What if engine fails during the tour, other equipment failure, avionics and such? And last but not least, passenger problems.

The important thing we stress here is to have a plan and think about what options are available when suddenly an emergency exists and, again, to use all resources available. Get some help from someone else: tower, dispatch, other tour aircraft in the area.

We give the pilot a hypothetical problem and certain known facts and have him make a decision on what he thinks is his best course of action. We get some pretty interesting reactions to this approach. We find it a good learning situation and a valuable insight to an individual pilot's decision-making process. This also is very appropriate for our Twin Otter crews. We are trying to bring that in now with our new crews.

We have experienced all these "what-if" that you see up there on the screen. I'm not sure if that's good from all standpoints. 1. Fuel starvation Fortunately, we haven't had any more horror stories since Tampa. If you want some more on that, I'll tell you in the next couple of days. 2. Engine failure or power loss especially after takeoff. Dick alluded to that. we did lose a airplane three years ago, and that was before the ATC 810. The engine problems we have had since then, (we have had three engine failures or power loss) resulted in all aircraft returning to the airport after feathering the engine and flying the aircraft back in with a maximum load of nine or ten people. 3. We've run the gamut on gear malfunctions. I won't go into that other than

we had some real problems with the Titans back when we first got them. Some of you have been flying 404s, you remember initially there was a problem with the main gear tires not coming out of the wheel well when we put the gear down. One gear would come all the way out and lock and the other would hang up in the wheel well itself. This happened four different times within about two or three months. Fortunately, I was in a position to hop in an airplane and go up and rendezvous with the aircraft and act as chase pilot and try to calm the pilot down a little bit and go through a g force maneuver. And of course with nine or ten people that's always a lot of fun. Not only were the passengers hysterical, the pilot was getting that way about that time too.

As I mentioned, one main gear was down, with the other tire hanging partially out of the wheel well. What happened, the tire expanded and would not physically come out of the gear well itself. So with some maneuvering and a little praying and a little hoping, finally all those incidents were successful.

The most serious one was about five miles out on final at McCarran Airport in Vegas with the runway foamed, figuring that we were going to have to make a single main gear landing. Of course, going through all the emergency procedures and the emergency gear system obviously wasn't going to really help him at that time. But five miles out, out comes the wheel, and it went down and locked. So fortunately we were successful on those particular incidents.

The point here is to learn from the experience of others in similar situations and try to eliminate the obvious bad decisions and emphasize the basic principles of resource management.

The one I didn't mention was passenger problems. Of course, you get everything from an overly talkative passenger -- I think John Lauber mentioned in his pitch about the person that is over there in the right seat just asking questions: Why do you do this? Why do you do that? What's that down there? Why is that airplane going this way when we are going that way? And the hysterical passenger, of course, can be a real problem. We have had several of those. I personally have had several, and I hope that's no reflection on my flying.

But normally our tour takes about an hour and fifteen minutes, and for some reason they don't get hysterical until about halfway over. So you're really too far to turn around and go back, and the other people, of course, are probably reacting to that individual who is getting hysterical. And

it can be a real problem. Fortunately, we have been able to use the other passengers that are in the airplane to help calm the person down, but the main problem is a small airplane, confined seating, and of course a claustrophobia-type reaction. Fortunately, we haven't lost a passenger yet, so maybe we've done something right. Also reasonable aircraft control, the ability to follow instructions from outside the cockpit, and the use of check list are important factors. We try to stress the point that in different situations there are different approaches to the problem. There may not be a single best solution. This is discussed during the debriefing with an exchange of ideas between both the pilot and the instructor. Probably one of the best measuring devices to evaluate the effectiveness of our total effort is the overall improvement I personally see as check airman, not only on local check flights but on the line checks during regularly scheduled flights.

With the additional information we pick up at such get-togethers as this, we hope to be able to further improve our training effectiveness and overall flying safety.

That's our new Twin Otter. I had to put a plug in for you Otter fans out there. The windows have been expanded at least three times the normal window size of the Twin Otter probably as you know it. A little better view at the top there. The passenger visibility from those large windows and high wing is tremendous. We are getting some real good reactions from our passengers that you can see forever out of either side of the aircraft. Of course it's designed and it has been modified as a tour airplane. The old beast still goes 130 knots, and it's really working out well for us.

I remember in Tampa last year I invited you guys to come by and ride in a Ford Trimotor. We haven't been flying it there too much lately, although we still have the Ford Trimotor. But if you get into Las Vegas and have the time, come out and see us and we'll try to get you a ride on a Twin Otter. If you haven't been over the Grand Canyon looking out one of these huge windows, you really haven't lived. So with that I'll close and entertain any questions.

DISCUSSION

MR. COLLIE: What Jim didn't tell you, they've got lambswool seats throughout the airplane including the pilot's seat. What he also didn't tell you is that about 80 percent of their passengers are foreign nationals. When they get hysterical, they get hysterical in their native tongue.

CAPT. LAWVER: It all sounds the same.

MR. COLLIE: Jim, thank you.

Next on the program is Captain Mike Sele, the chief pilot of Air Wisconsin. Air Wisconsin is the only member of the Regional Airline Association that is operating a four-engine turbo jet airplane. They put it in operation the 27th of June, and as a result Mike has not been able to accomplish all the CRM activity he had planned. He's been busier than a one-arm paper hanger all summer trying to get the BAE 146 into operation. So, Mike, will you give us a rundown on your CRM activity?

USE OF AIRPLANES FOR LOFT TRAINING

Mike Sele

Air Wisconsin

CAPT. SELE: The use of an aircraft for LOFT training or line oriented flight training is something that we've all been doing for a number of years. We probably didn't call it LOFT. We probably called it upgrade training or new hire training or transition training. Or my specialty is remedial training. That's for those of you who know what that's all about. In case you fail the check ride, I'm the guy you have to come and see.

We've been doing some experimenting and some evaluation using the airplane. We've also seen some very good positive points for the use of an aircraft. First and foremost, I guess, all of us who fly airplanes have the equipment so we don't have to go out and buy a simulator. We don't have to go out and buy a table top or anything else. We've got the airplane right there. All you have to do is make one mistake and you'll find out.

One of the areas that we thought was another positive point for this was flight crew workload. We had been involved in this program for quite some time with Dr. Lauber's speech back in Tampa. And one of the things we were concerned with or I became involved with is if you put somebody in a chair and let them sit there all day to make a decision, it's real easy to make a real good decision. But if you get that man in the chair that's going through the air at 400 knots, and the fuel is going out about that fast and you have to make a choice, that changes the picture a little bit.

We also found some very important negative points I guess is the best way of describing them. One is safety. We put the British Aerospace 146 in service on June 27th, and we picked that particular airplane up in England a couple of weeks prior to that. I was fortunate enough to be able to go over and get the airplane and bring it home. When we got it home we had to get the airplane configured with the seats. We had to have a conformity check by the FAA, then we had to go through the proving runs. Part of the proving runs turned into a real circus. Dick Collie was out there and rode along with us a few days on that, and he can attest to the fact that it was indeed a circus.

We had a number of crews involved, and we had one management pilot, one line pilot, be it a captain or a first officer, fly the airplane. We had FAA representatives on board, of course, in the jump seat. We had FAA representatives in the back. We had manufacturers representatives and some maintenance people and all of this sort of stuff. But what we primarily did is look at this as an opportunity to evaluate the use of an airplane for LOFT training. Our evaluation process was that we had my director of training, my director of in-flight training, another check airman, and the line check airman involved in the program. They were able to observe during this process how we could in fact do that kind of training in this airplane. You have to have some airplane where you can get somebody up in the cockpit, we felt. Both the Dash 7 and the 146 have adequate jump seats. We have those people up front; they can watch it.

The big issue that came up right away at the top of everybody's list when we got through with this program and asked for an evaluation of it was safety first and foremost. If you have two line pilots in the airplane and an instructor, we are real reluctant to do a massive AC failure. You don't always start out with the a massive one, but if you were familiar with the Dash 7 or the 146, you can start shutting down AC systems and pretty soon you can have a massive.

So we considered the top issue there was the safety of using the aircraft for that. That's the reason that the simulation business got started, I think, in the beginning. Another consideration in using the aircraft is economics. You are going to have to pay for the crew costs, the fuel, the maintenance and all of the rest of the items. And the availability of the aircraft is another one that had to be considered.

We have one 146 running at the moment. The number two airplane should be leaving England in about 24 hours and be home in about 48. It will be on the line on Sunday, providing that the weather agrees with us up in Gander and we can get through there.

So aircraft availability is a problem since we in the regional airline business or commuter airline business fly the airplane from six o'clock in the morning until 11 o'clock at night. Maintenance wants the airplane at 11:05 and wants to give it back to you at 10:15 the next morning, the usual schedule. So we are competing with them, and we are doing our flight training, our check rides and this type of thing in between those hours. That's a very difficult task to be accomplished, particularly when the vice-president of maintenance is a lot larger than you are.

I know that many of you have different problems than we at Air Wisconsin have in this area. We have a different operating environment. I don't know why the fellows down at Scenic go through instrument training. I don't know if they have ever seen a cloud down there. Those of us that are operating in and out of Chicago all the time get a few clouds. Some of them are manmade even.

I hope that as a result of this seminar that all of us can obtain the information necessary to begin or to go forward with a cockpit resource management or a LOFT training program. I am going to be chairman, I understand, of group number five, and we will be happy to entertain any of those questions at that time in reference to any of those items or anything else that you have. I am going to cut this very short and say that we are open for questions at this time in the use of the aircraft or in any other areas. Thanks, gentlemen.

DR. LAUBER: I'd like to jump right into the planned presentations for this morning and introduce our next two speakers. We're going to be talking about airman education and safety awareness programs including a presentation on the Aviation Safety Reporting System. Jack Enders is currently president of the Flight Safety Foundation and has been there since 1980 in that capacity. Jack has a total of 30 years of experience in aviation starting back as a NASA rocket research engineer which has a kind of spiffy ring to it. He was an Air Force pilot flying the RB47, C45, U3. After completing his Air Force tour, he became a NASA research pilot and was involved in zero g flight testing. Then, for a long period of time he planned and directed NASA aviation safety research and development in all kinds of areas, whether research, crash fire research, tire design, all-weather landing protection and a whole series of things that Jack was involved in during his years at NASA. He was also on temporary assignments to this office of aviation policy with the Executive Office of the President and in the FAA office of aviation safety, and has served on many safety oriented committees and panels, authored many technical reports. We're very pleased to have Jack with us this morning.

The second speaker will be Bill Reynard. Bill is chief of the Aviation Safety Reporting Office here at NASA-Ames. Bill is a lawyer, but we've all forgiven him for that. He's also a commercial pilot with instrument and multi-engine ratings. He's a graduate of Ohio State University, which in the opinion of some of us, makes up for him being a lawyer, and before joining the Aviation Safety Reporting System was the executive director of the National Association of Flight Instructors and was with the AOPA in Washington for a period of time.

SAFETY AWARENESS, PILOT EDUCATION, AND INCIDENT
REPORTING PROGRAMS

John Enders

President, Flight Safety Foundation

MR. ENDERS: The decade of the 1980's may well become known as the decade of destabilization in air transportation. I'm going to give you a little background on a broad view of safety which is far beyond the regional picture, but I thought it might help to set some sort of a perspective for remarks that I'll get into a little bit later about safety awareness and pilot education. The economic upheaval domestically and overseas has created all manner of pressures on aviation operations that can and do have erosive effects on the remarkable margin of safety that we've so painfully constructed over the past two decades. The record is a record to be proud of. Internationally last year, the ICAO scheduled airlines carried over 740 million passengers in operations totaling over one billion passenger miles. 740 million passengers is about two and a half times the total population of the U.S. or three-quarters of the population of Mainland China. So, they moved a lot of people. There were 23 fatal accidents accounting for 732 lives lost. Now, 732 lives lost, as regretful as that loss is, out of 740 million seems to me like a pretty darn good risk.

During our annual International Air Safety Seminars the Flight Safety Foundation has been privileged in recent years to have Mack Eastburn, Senior Safety Officer of American Airlines, present the leadoff paper, "How safe are we?" It is a yearly report on the running average of safety achievements throughout the world. Mack uses an unconventional measure of safety: Jet hull losses per jet flying hour. While there are many airlines flying today that are using propeller equipment, I feel that Mack's criteria probably provides a useful measure of safety achievement.

Can I have the first slide please? This slide shows the overall cumulative safety record in terms of jet operations. You can see that the U.S. has accumulated about two-thirds the total flying time of the world in general, and it accounts for about half of the hull losses, so the U.S. operations are ahead of the rest of the world, safety-wise.

The second slide shows a comparison of the hull loss rates in terms of hull losses per jet flying hour. One can

see that the United States loses one jet hull, which may or may not be a fatal accident, but representing a severe accident, in about every 860,000 jet flight hrs. Australia and the South Pacific region come in as champions with one hull loss in about one million nine hundred thousand hours. These, incidentally, are not regions of registry of the aircraft, these are regions where the accidents occur, so they reflect not necessarily how well an airline is running -- is run, but primarily the environment in which the aircraft is operating. Europe comes in pretty close to the U.S., but Asia and Africa and Central and South America are down at the low end of the totem pole. This gives you a perspective on the U.S. record in relation to the rest of the world.

This next slide is just a trend graph, on a slightly different scale, and you may have seen it before, comparing the U.S. hull loss rate with the rest of the world. You can see the U.S. comes in pretty well by comparison.

Comparing the hull loss with the fatal accident rate in this next slide shows that they track pretty well together.

This next slide shows another method of looking at air safety in the U.S. It was put together by Nick Engler of the University of Dayton Research Institute. It shows the fatalities per million passengers carried. Going back into the early phases of air transportation, you can see that the rates were pretty high. The risks were high back in the 20's and 30's, and they've fallen pretty dramatically. This is plotted on a logarithmic scale, so the falloff is quite substantial. The rates are down pretty much now in the realm of wondering if we can do any more to improve the accident rate by looking at the improvement of the aircraft or the system.

This next slide is just an impact chart that shows that accidents, in addition to costing lives, cost a lot of money. Someone has to pay it, but if we don't have to pay it, we'll have plenty to develop air transportation. So that's an economic plug for safety and gets away from just maybe the altruistic and very moral view of saving lives.

This next slide is another presentation that you may have seen before of the distribution of hull loss accidents by phases of the flight. Of significance here are the numbers at the bottom that show the percentage of time of exposure to the different phases of flight. The figures at the top show the actual percentage of accidents occurring in each phase of flight. So, for example, in 12 percent of the time spent in takeoff, initial and climb phases, initial climb and climb out, thirty-eight and a half percent of all accidents occur in that regime, and of course, in the

landing areas, as you would expect, 53 percent of the accidents occur with a 14 percent exposure time.

This slide presents factors in fatal accidents that have been determined by the appropriate authorities. It does set the priorities where work really needs to be done. You can see that the crew human factors area needs some attention.

The reason that the U.S. comes in pretty well on this comparison bears witness to a unique situation that we have here in this country. The U.S. manufacturers account for about 80 percent of the world's airline fleets. The FAA, manufacturers, and airlines have an integrated relationship in this country, unlike other areas of the world, that provides a most efficient and standardized feedback, imperfect as it may be. The U.S. and Europe also have the advantage of a larger pool of skilled and educated workers to draw from for the aviation effort. Yet, only two decades ago, our record was not one to be proud of. We have learned from experience. Not only was the FAA a powerful force for compliance with good operating practices, the pilots' organizations spent a great amount of effort in educating their members and fostering safety awareness. The airlines gradually established safety officers or departments to give emphasis to the need for attention to operating in a safe manner. Airline engineering departments served the safety function admirably through their quest for efficiency and reliability. There were a lot of things going for safety improvement in the United States.

We have come a long way in establishing this record of safe travel and dependability in the minds of the majority of passengers. The level of operational safety far exceeds that required as a minimum acceptable level of safety by the regulations. We call this exceedance of the margin of safety. It cannot be measured in quantitative terms, but it is comprised of many, many factors. For example, the mechanical part of the system has evolved to a very high degree of reliability. The communications network, though we can all find fault with it, permits far more information to be passed than ever before. Navigation equipment and weather radar provide means of precise reckoning and avoidance of severe weather. Maintenance methods have also improved with new ways of insuring that the machine and its equipment will perform properly. And training methods, as we talked about yesterday, have, of course, improved drastically, as has our understanding of the human operator and the ways in which he makes decisions and performs tasks.

Technology is the handmaiden of aviation progress. Always responding to economic factors, technology has provided the performance gains that traditionally kept the

airline one step ahead of the bankers. The economic pressures now being felt have generated a flood of technical innovations that are appearing in cockpits, structures, engines and accessory equipment. Coincidentally, these pressures are changing the procedures that we have traditionally become used to. Route structures are changed, new freedom of entry and exit to the markets is testing the conventions of aviation. In short, we are operating in a destabilized environment.

The history of air transportation development is replete with examples of moves to standardize certain functions. For the most part, this standardization was rationally undertaken as a result of the findings of many accident investigations that clearly indicated an inability of the designer to anticipate certain actions of the crew or performance of the airplane under unexpected operational conditions, and an inability of the crew to control many variables at once during critical phases of the operation. Thus, we have the standardized three-degree glide slope, checklists, maintenance procedures, standardized training requirements, standardized medical checks, crew rest regulations, standardized weather observation formats and so on, all effective in cutting down the amount of uncertainty of when the pilot has to make a decision either in flight planning or in operation. Gradually, the supporting infrastructure of the aviation business grew to insure that the pilot could make his decisions with a reasonable amount of confidence. This has resulted in a stabilization that has established a very comfortable margin of safety. It translates into a system that is very forgiving of error.

However, it's worth noting that while the human intellect has created this marvelous system, the human in the cockpit that has to contend with all these improvements, often making snap decisions that can determine the difference between safety and tragedy, is still the old Mark I Human Being that went aloft in balloons in the 1700's, attempted heavier-than-air flight in the 1800's, and triumphed at Kitty Hawk in 1903. There has been no comparable improvement in old Mark I Human Being as regards skeletal or muscular strength, speed of reaction, improved vision and hearing, mental capacity or any other human attribute.

We don't even have a Mark I, Mod I or Mod II!

So this presents us with the dilemma of how to use this new technology to its best advantage and still maintain control over it. We have to determine how to bridge the gap between the capabilities of man and machine.

Added to the technological challenges just mentioned

are the changes in the operational picture. Deregulation has spawned an entirely new operational game. Smaller airlines have organized and have entered the market with lean organizational staffing. And yesterday we heard very clearly how well they are coping with this situation. They've done very well safety-wise, so far. The larger, older airlines have been forced to trim staffing. To date we have seen medical staffs, meteorology staffs, engineering staffs and safety staffs cut back or eliminated. In a stabilized environment, these impacts might be accommodated with little effect. However, I wonder how well the managements of the large airlines and the new entry small airlines are coping with introduction of this flood of new technology and the other changes in the system. The answer must lie in how the safety function is preserved within this new situation. Human beings are remarkably adaptive organisms, and if the motivation is right, they can function in a variety of effective ways. The bottom line is that the organization must provide for effective means of selecting, training, motivating, supervising and supporting its flight and maintenance crews to ensure that they have the best grounding in knowledge and experience available.

SAFETY AWARENESS

The term "Safety" defies precise definition. Jerry Lederer, in his Wings Club address last year on safety perspectives, noted that safety is a relative term that must be interpreted in the context of what is acceptable to the public. Some people would rather speak of risk management than safety. There is a subtle difference here. The term risk management confronts reality and recognizes the inevitability of risk. Safety, on the other hand, implies an ideal that must be sought, though never absolutely reached. Perhaps it is a matter of attitude. Maybe we'd try harder if we seek safety than if we merely manage risk.

But risk management is a good concept. The idea of managing risk appeals to the ego because it implies control. Safety is more of an abstract concept. Risk management lends itself nicely to processes that can be measured, such as insuring reliability in hardware performance. If one can define a failure rate of a component by keeping performance records of a large number of components, one has a quantitative handle on the risk of failure. When we get away from hardware, however, and talk of human error or failure in the context of risk management, we have quite a different situation. We are no longer in a quantitative field; we are very definitely in a qualitative or subjective mode.

What then of risk? Risk comes about because of ignorance, coupled with a perceived need to act. At the very simplest, for example, if we get into a cockpit of an

airplane that we haven't been checked out in, and proceed to fly the boss and his staff to a distant airport without checking the weather because the boss said that he had to get home right now, there's no one in this room that would dispute that this operation is potentially at great risk. On the other hand, if we are thoroughly checked out in the airplane, have practiced extreme emergency procedures in the simulator, have a lot of time in type, have a strong background in understanding weather and experience in flying in bad weather, and maintain a professional awareness of safety factors, and have a boss that defers to his flight crew's judgment about the likelihood of safely completing the flight, I think you would all agree that the risk has been substantially reduced. To the extent that the several factors mentioned in this example can be managed, we have managed the risk.

Man is a risk taking animal. He will always chafe at boundaries, probing, testing and finally venturing beyond to see what awaits. If it weren't so, we would have ceased to exist as a species long ago. Sometimes he's successful; sometimes he's surprised; and sometimes he dies.

Since it is inconceivable for man to remain inactive, he must act. We must, therefore, reduce our ignorance in order to reduce risk, or preferable, to closely approach that idea of safety. We do this through learning as much about our machines as we can, by learning as much about the environment in which we will be flying, by learning as much about our organization to make sure that we understand its inevitable weaknesses, where they are, what department one can depend on strongly, or when it is better to take a little extra action on our part, and by learning as much as we can (or dare) about ourselves. We must keep our minds and bodies in as operable a shape as possible against that ultimate challenge that a "Murphy" or electronic glitch or Mother Nature will eventually throw at us, usually at the least expected time.

We must maintain an awareness of all the factors that affect safety of flight and ensure that they are under control, either through the design or through our skillful operation.

Pilot education sometimes has been described as a horse watering problem. I will attend a meeting of the Orient Airlines Association in Manila next week that has the theme: "Changing Attitudes in the Face of Progress." The papers that are to be presented deal with the interface between the human and the system. Since the system is designed by humans with all of the potential for error that that implies, we are faced with the problem of educating a pilot to deal successfully with a system that may or may not work the way it is intended to work. There are many management textbooks written about decision making under uncertainty. This is certainly a good description of the pilot's problems.

The pilot starts out with his initial training, followed by some period of logging time and gaining experience. If he's wise, recurrent training will follow either in flight or simulator; preferably both, and study. I hear from a lot of old heads these days that the younger generation coming into the flying game is not hitting the books like they should off duty. I don't know whether that's true or not. I hope that it indeed is not true. There's no way that a pilot can learn everything needed to keep out of trouble without spending a lot of time burning the midnight oil, learning everything he can about the aircraft types he's flying, about weather, procedures,

emergency procedures, aerodynamics, operations in foul weather and so on. The profession of flying demands an absorbing mind. The professional pilot will prepare himself for the eventual transition into new equipment without waiting for the formal company training program. He'll maintain an awareness of what's coming down the road and be ready for it.

Jerry Lederer is fond of quoting Ralph Waldo Emerson's phrase: "Learn from the mistakes of others, you'll never live long enough to make them all yourself." And that was more or less the basis for the founding of the Flight Safety Foundation. And we follow that theme today. The individual airline pilot has a difficult time finding out about safety information outside of the institutional issuances of FAA bulletins or the manufacturer's directives. The Foundation publishes quite a number of bulletins, as shown in this montage I also have here with me a sample binder full of a year's bulletins that you're welcome to peruse and look at, at your leisure. I wish that I could have brought enough to send home with everybody, but that was a physical impossibility.

We find a wide variance among our 400 member organizations in how they make safety information available to their employees. In general, there's a good correlation between airlines and corporate flight departments that have excellent safety records and those that have some identifiable safety function, whether it's an actual safety department staffed with several people, or an individual that is designated as safety officer, or the function is preserved within the normal operational organization. The more enlightened airlines establish this function to be the organization's safety ombudsman with full support of the management. And when I say full support of management, I mean just that; that management does not interfere or become nosey about who's doing what, but that they want to make certain that there is, as it were, a neutral third party or ombudsman within the company to whom the crews and the maintenance people can confide if they've got safety problems. We've heard variants on this yesterday in some of the descriptions of how the regional airlines were coping with the problems.

The safety function collects and disseminates safety information from within and without the company to operations, maintenance and management. In full mutually supportive partnership with management and the operating crews and maintenance staff, this can be an extremely effective function in keeping the airline out of trouble. One of the many pilot organization members of the foundation has contracted with us to furnish every member of their organization with a personal copy of our monthly Accident

Prevention Bulletin. That came about because in some companies, who were full members of the foundation, our bulletins never got beyond the operations director's desk, so the pilots' union took it upon themselves to spread the word to all of their operating crews. Now, on the other hand, many airlines distribute our full range of publications to their pilot domicile offices where they are available for perusal in the pilots' lounge or on the bulletin boards. Nearly all of our airline members reprint or extract from our publications in their internal publications on safety and operations.

This last slide that I have here is a representation of another safety function that the foundation provides in terms of workshops and seminars. We have every Autumn an international air safety seminar directed to air carrier flight, primarily, but not exclusively, international and big iron. It's held at various locations around the world: Rio this Autumn; we were in Johannesburg last year, in Christchurch, New Zealand and in Acapulco before. Next year we'll be in Zurich, and then in 1985, we'll be in Boston, and in Vancouver in 1986. I hope that many of the regional airlines here will take advantage of attending and having a chance to meet colleagues in the business from overseas and to exchange ideas and thoughts about safety.

These seminars and workshops are unique because the Foundation is an independent, nonprofit organization. We have no ties to any government or single aviation faction. We provide these objective forums where safety issues of a sensitive nature can be discussed without rancor or incrimination, and they've worked pretty darn well over the years.

The point of the foregoing is not that the Foundation is the only source of safety material. There are many excellent publications that feature useful and practical articles on safety and safety related topics. Mentioned yesterday were good articles in Business Commercial Aviation, for one; Flight International, Aviation Week, and the fledgling International Journal of Aviation Safety are others.

The FAA publishes a host of material on safety from the Airmen's Information Manual, to Advisory Circulars, to research reports, covering a variety of topics concerning the airplane, the system, weather, human factors, and air traffic control. The NTSB's accident reports and their green sheets convey vital information about the probable causes of accidents.

Are they available to the pilots? How many of you here regularly see these sorts of things? Do you get this

filtered down to you? Not much -- not much transmission of information. Of special significance are the excellent publications coming out of the NASA Aviation Safety Reporting System Office. CALLBACK and the quarterly reports contain information about human error that is simply unavailable anywhere else. NASA has done a great public service in making CALLBACK available to individuals who express an interest in receiving it. The special reports are undoubtedly less widespread. Company safety officers in what I call the enlightened airlines avail themselves of all of this, they make copies available for direct perusal by their staff or they publish excerpts or the meat of these faults and articles in their company bulletins. But, then, we come back to that old horse watering problem. How many pilots take the time to read it and educate themselves? And the manufacturers publish good stuff, too. Coming to mind is Douglas' DC approach, and the Boeing Airliner, and so on. They contain excellent information about safe operating practices. They're generally available for the asking. But, again, I suspect that most of you are unaware of the existence of a lot of this or that you can even get them on an individual basis.

Well, the Foundation was founded on the principle of sharing safety experiences among its members. To that end, we regularly receive the in-house publications of most of our operational members worldwide. It gives us a very unique perspective on safety matters. Our publications reflect this perspective in topics as diverse as human judgment training, mental incapacitation, wind shear warning, and so on, and you'll see these and other topics referred to in the sample bulletins here. There's a wealth of safety information available. What is done with it is another matter. That depends on the individuals' or companies' attitudes toward safety. I suspect that an organization that has had a fatal accident in its experience has a much different attitude about safety information than one that has not been through such a tragedy.

One of our airline members has established a safety department headed by an active line captain, assisted by a full-time returned military pilot, and augmented part-time by two flight crew and two cabin crew staff members. This safety department reads every flight record and consults privately, without recrimination, with crews of flights where irregularities are found. This safety department has established a rapport with the crews that encourages pilots and flight attendants to come to them with concerns about particular flights or situations that need correction. I would suspect that the margin of safety in that airline's operation is substantial.

At the other end of the spectrum is an overseas

conference attended by the Flight Safety Foundation several years ago when the Aviation Safety Reporting System was just beginning in this country. When our delegate recommended the establishment of an anonymous reporting system like ASRS in their region, one of the flight operations directors attending spoke up that in his airline, if a pilot committed an error, he was expected to tell him about it; then he would determine his punishment. How foolish we are if we don't listen to what's going on in our own organization and take action to improve the situation.

Well, to sum up, then, risk occurs because of ignorance and the perceived need to act. We must carry on the operation, so the perceived need to act is there. We have to act. If we act with knowledge, the risk is reduced. It behooves every pilot and his company to avail themselves of every bit of safety and operational information possible and to employ it in a professional manner to ensure that the flight will be routine. The Foundation and these other organizations I mentioned are here to help you to find the kind of information that you need, and if we can help out in any way, don't hesitate to call us. Thank you.

DISCUSSION

DR. LAUBER: Thank you, Jack. Why don't we, before we put Bill Reynard on, take any questions for Jack Enders. Do we have any out here? Ed Carroll has one.

CAPT. CARROLL: Jack, maybe there's something to be learned from the Australian, South Pacific experience. The numbers seem to indicate that they have better than two times the exposure or safety record that we have. And also, I guess an associated question as to what we might learn from them, in that regard, is their ratio of cockpit crew problems parallel to ours, or is there a sharp distinction there as well?

MR. ENDERS: There have been a lot of people looking into why that region of the world has substantial margin over the rest. There are several factors, I suspect, that are at work here. One is that the Australians have had for many years a mandatory reporting system. By law, pilots are required to report incidents. I've talked with pilots over there who are of the opinion that if they didn't already have it, it would be impossible to establish such a mandatory system in today's social and economic environment, but they have it, and they're holding on to it. And so I think that system coupled with lower density operations, and while they certainly have fog and low visibility weather, they don't have the extreme climatic changes that much of

the rest of the world has, are positive factors in their record. And the other very real factor is that since they're so far from anywhere, aircraft log a lot of time enroute, so if you look at that other graph, that shows 53 percent of the accidents occur in the approach phase, it adds a lot of "nonevent" time. I think all of these factors account for their good record.

CAPT. CARROLL: How about the crew involvement?

MR. ENDERS: I don't have enough information about that to offer an opinion, Ed.

DR. LAUBER: Other questions for Jack?

Thank you, Jack. A matter of curiosity, how many airlines represented here, have a recognizable safety department or an individual in charge of safety? Can we have a show of hands on that. How many publish a safety bulletin or otherwise disseminate safety information? Okay. I was curious as to exactly what the situation was.

With that, I'll turn the podium over to Bill Reynard for discussion of the Aviation Safety Reporting System, which is another approach to pilot safety and education, and, again, offers a rich source of material that you people could use in putting together safety awareness programs. Bill?

THE AVIATION SAFETY REPORTING SYSTEM

W. D. Reynard

MR. REYNARD: Good morning. Happy to be here to give you a few minutes worth of description and a background on the Aviation Safety Reporting System.

Jack and I are in the information business. One of the greatest travesties that exist in any industry, but particularly in aviation, is to have one group of people possessed of useful information that cannot, will not or somehow is not shared with another group that could use the same information. We try to overcome that by the Aviation Safety Reporting System. It's an incident reporting system that was initiated in 1975 at the instigation of the Federal Aviation Administration as a result of TWA 514- at Dulles Airport, as well as recommendations through the course of years. As you all know this incident reporting is nothing new.

In 1975, the FAA instituted the Aviation Safety Reporting program, ASRP. It looked very much like the ASRS looks now. The problem was the reports were being sent to the FAA. You can imagine how thrilled the community was at the prospect of sending reports of human error and incidents to the same organization that's going to be writing the tickets if, in fact, there's a violation of the FAR's. Consequently, the FAA, in its wisdom, looked about for a disinterested third party. Everybody agreed on NASA simply because we have a good research background, we've got talented human factors people, and most importantly, we don't have an enforcement mandate.

Consequently in 1976, the Aviation Safety Reporting System, ASRS, was initiated. And it's housed here at Ames primarily because we have the life sciences directorate and the human factors research group in this facility.

The purpose of the ASRS is essentially twofold. We identify deficiencies and discrepancies now. And if we can put a fix on and get something cured in a short term, that's good. If we can also use the data for long term identification of problems, explanations of why and provide data for planning and policy making, that's even better. So we essentially try to approach it with those two objectives in mind.

The concept is a relatively simple one. The Aviation Safety Reporting System is absolutely voluntary. Nobody has

to report to ASRS. As opposed to the Australian system and the British system, our system regarded voluntariness as absolutely critical. We didn't want anybody to feel compelled to do something in the sense that all of us have had to fill out forms, accident reports forms, any number of things that involve a discussion of what we've done. In those circumstances you usually end up with somebody just filling in the blanks. They tell you as much as they need to tell you, and that's it. We wanted to get over that, because the real goal was to set explanations of why things happen.

It's confidential. We're absolutely paranoid about confidentiality. In the course of seven years we've received in excess of 35,000 reports, and we've never blown anybody's identity. That is the cornerstone as far as I'm concerned of the ASRS system. We deidentify all the information that is put into our data base, so that by the time it's put in there for use for research or whatever, you cannot tell who sent in the report, nor can you tell any of the actors in the report, because we deidentify everything. Not just the person's name, but also the time of day, the date, the make, model, flight members, air carrier names. We have found suitable substitutions, because what we're dealing with are safety issues. We don't really care who did it. We want to know what the safety issues are, and even more, why it happened.

And finally, it's nonpunitive, and in this respect, it's nonpunitive in two ways. No. 1, NASA's mandate does not include enforcement. We couldn't nail anybody's hide to the wall if we wanted to. We just don't have the authority. So consequently, we won't proceed against anybody if we see information. We don't even tell the FAA when we see a violation. The agreement that we have with the FAA is if they can find out about an enforcement violation through some other means, then they obviously have the right to pursue it, but they can't use our data to do that. Nor are we going to call them up and say such and such happened at Chicago on such and such a date and think you should look at it. We simply don't do it. They don't ask, and we don't give.

Secondly, and this is something that most of you may have had some familiarity with, the FAA in conjunction with the ASRS offers a waiver of disciplinary action. This has been true ever since day one of the program. Essentially what that says is, in fact, the exact words in the advisory circulars are, "Reporting to the Aviation Safety Reporting System is indicative of a constructive attitude." Therefore, we (the FAA) will provide a waiver of disciplinary action for those people who qualify. Essentially what the qualification is, the act has to have been inadvertent and not deliberate. You cannot have been found guilty of a

violation of the FAR's since April of 1975. Now, as we grow older in our program, we're going to change that so that the date slides, because obviously the further away April '75 gets, the less meaningful that becomes. So we're going to put in a sliding scale on that and that will probably be in effect next year.

You also have to report in a timely fashion. You have to have mailed the report within ten days of the event. And the lawyer in me wants to point out that if you are, in fact, interested in immunity, you have the burden of proof of establishing that you met that ten day period. So one of the great legal tricks is send it certified return receipt requested. That way the post office gives you proof that you mailed it and it also gives you evidence in case it gets lost somewhere between you and me.

Regarding disciplinary action, it essentially says the FAA can investigate an incident, and if there is a violation of the Federal Aviation Act or the Federal Aviation Regulations, they can, in fact, find you guilty of having violated whatever FAR is involved, but they can't do anything to you. There will be no certificate suspension, there'll be no civil penalty, they simply go up to the point where they say well, we've investigated it, you did it, but because you shared the information with the Aviation Safety Reporting System and it's there for safety purposes, we are not going to impose a penalty. It's a very workable system, and it has worked quite well in the course of seven years. We had a little ripple in 1979 when there were some misunderstandings, but we got that straightened out, and I think we actually have a stronger system now than we did going into that misunderstanding.

This is the reporting form. Hopefully all of you have seen. Hopefully all of you have copies. Tomorrow night or tomorrow afternoon when you leave here, I will have on the back table as you go out the door a sufficient supply of various publications and reporting forms that if you want to, you can take them back to your domicile. If you need more, simply let me know. The address will be associated with the information I have, and you can get a supply of as many as you want. We print about a hundred thousand a year. So we aren't lacking for supplies, and if we know ahead of time that you need an unusual amount, we can also include that in the printing order.

You can see that it's in two forms, essentially. The top part is an identification strip that is hopefully filled out along with the bottom part, which is essentially the meat of the form. The top part serves two purposes. No. 1, it's a mailing label, if you will, to send information back to the person who sent the report to us. There's nothing

worse in Government circles as far as safety than sending information that has been volunteered to a Government organization, and then never hearing anything. It's like there's this huge crack in the earth and all the information goes into it and nothing ever happens. Well, we've tried to overcome that, because whenever anybody sends us a report, we send the ID strip back with a thank you letter, two blank reporting forms, our monthly safety newsletter, and, of course, the ID strip, which serves as a receipt in case the FAA does pursue an enforcement action. The last paragraph of the current FAA enforcement letters, which will notify you of the finding of guilt, saying if you have filed a report with the Aviation Safety Reporting System and can provide proof of that, then the disciplinary action will be waived if you meet the qualifications. So what you simply do is xerox a copy of the ID strip and send it back with your response to the letter, and it works.

The bottom part of the form is what we use for our analysis. It has 14 items of what we call fixed fields, and the very bottom part is the narrative description. That's where the reporter says what happened and essentially provides a description of the event, a discussion of what the basic underlying reasons were, and possibly recommendations to avoid it. I am convinced that's where the pure gold is. You can fill out all kinds of little boxes like that on other forms, but when you have the chance to have somebody fill out the reporting form and say this is what happened in his own words, it does two things: No. 1, it helps create a good safety base which we can then turn around and share with the aviation community. So when you sit down and think about what happened and analyze it, putting it down has proven to be very beneficial on the part of the reporters. I don't think I've gone to a major pilot meeting yet where one of the pilots hasn't come up and said I don't give a damn whether you people do anything with that information or not, just sitting down and having to think about what happened has been beneficial to me. So consequently we're getting a double benefit on that section.

I do want to note that we do not accept reports of accidents or criminal activities. Those are specifically excluded. Accidents have to go to the NTSB and criminal activity reports are forwarded to the Department of Justice. It hasn't been much of an issue, but I feel compelled to tell people that simply because every now and then you get a report of an accident. We're like anybody else. If we possess information about an accident, we have to send it to the NTSB. But that's the only exception. Under no other circumstances does data ever go out of our office identified.

The database consists of three basic elements. The fixed fields, which are essentially those first 14 items on the reporting form that talk about the time of day, the flight conditions, et cetera, the factual as well as administrative. It allows us to recall the information in a timely fashion. Secondly, diagnostics are put into the database by our analysts. Our ASRS analysts are all retired aviators, either retired controllers, retired pilots, general aviation, air carrier, military. We made this decision early on because we thought it would make more sense to have somebody doing the analysis who knew the aviation system as opposed to somebody who knew analysis but not the aviation system. So consequently we've got what we call our "gray beards". These guys are all retired, and they've been around the system for a long time, and they know what they're looking at. They can provide the analysis and diagnosis. In other words, they describe beyond the words of the reporter what they feel were the circumstances and the factors which caused it to be an incident as opposed to an accident.

And finally, there is the free text. We retain the narrative description of every report that we get in, even though it costs a little bit more to do that as far as computer space is concerned, when crunch time comes, you want to do some meaningful research, the best thing you can do is read the narratives, because that's where you find out exactly what happened.

The program output has two functions: We want to notify the aviation community of alleged hazards by trying to turn the information around as quickly as possible to try and cure something if we can do it. If we have to do research, if the problem is a little bit obscure, we'll give it a priority that will allow us to do it in a timely fashion. We also want to explain "why", why does something happen. The value of the kind of information that we have in the Aviation Safety Reporting System goes to the heart of the fact that people will tell us things they don't tell anybody else, because they know that confidentiality is pledged and in the course of seven years and and 35,000 reports, it's been delivered. So consequently we can explain why something happens. The FAA may know that something happened or the NTSB may know that something happened, but in many cases, we can explain why it happened simply because the people will talk to us about it. Finally, the ASRS has an output program, and this is primarily what I want to talk to you about, albeit, briefly. We have five ways of getting the information out. And like I said, we're in the information business. We take it from party A and give it to parties B, C, D and whoever else wants it and can use it. The first and most timely example of this is our alert bulletins. If we see something

reported that seems to require immediate correction or investigation, we have the ability to either send a one-page notification, a telegram or pick up the telephone and call somebody, usually the FAA, who's in the best position to investigate or correct the situation. We let them know that we are possessed of information that would indicate that a particular problem seems to exist, and we think they ought to go out and investigate it, and if it is existing, they ought to fix it. Again, we do not identify the source of the information. We just simply say we have sufficient information that makes us believe that such and such ought to be investigated and possibly corrected.

In the course of the seven years we've been in business, we've issued 778 alert bulletins.

Quarterly reports, those are our program reports. Those are the means of reporting to the community what we've seen. They provide the de-identified reports for safety and training purposes, and they let the community see the kind of issues that we're addressing.

Technical reports are single issue research reports. Special search-study reports, that's kind of a two dollar word for a data dump. If you're going into a training mode, for instance, and you want to have data on, let's say, weather operations in the Northwest, you could call us up and ask for all ASRS regarding weather operations in the Northwest. We'll push the Northwest button and the weather operations button, and whatever else is appropriate, and send you a printout. That way you can use it in your training programs, you can use it to develop scenarios, any one of a number of things. Now, obviously, we're not a flight service station; we can't do a real quick turnaround, but if you have a legitimate, genuine interest to do some type of training or research, give us a call. We've got over 23,500 reports in the active database, 35,000 reports total, and we can respond to almost any inquiry.

And finally the newsletter. Those of you who are listed in the RAA directory of last year are already getting a copy of CALLBACK. If you are not getting CALLBACK, let me know. We can also make an arrangement whereby your pilots, individually, get CALLBACK monthly. Again, see me sometime in the course of the meeting.

We discovered several years ago, that the program reports are great, that the technical reports are great, but they were running 40 to 50 pages long, and most of us don't want to take the time to sit around and read 40 to 50 pages. So we came up with a single page newsletter issued monthly, that deals with safety, and is in common language. You know, people like us just don't talk the way Ph.D's do. The

fact of the matter is, pilots talk "pilot talk" and that's the way the message is best conveyed. So consequently, we've put out this single page newsletter that is basically safety oriented. We've tried to keep a light touch -- if you've ever seen CALLBACK, you'll know that every now and then, in addition to looking very serious about a safety problem, you'll also end up chuckling a little bit too. But we've tried to get the safety message to the community, and it's been very successful. We've won some awards for safety publications, one from the Flight Safety Foundation, and we're very grateful for that; but we're also very proud of the fact that we think that by the time you finish reading CALLBACK, whether you've chuckled or not, we've got you. You've read the information and the safety data has been transferred, and that's the name of the game.

Well, let me wrap up by saying that for the first couple of years, I felt like a carpetbagger going around the country saying gimme, gimme; gimme, because I needed to get reports into the database. We still want to get the reports, and I have to note that the smallest percentage of data supplied is by the commuter industry, and I would like to cure that. We stand ready to cooperate in any way by providing forms and publications. But more importantly, as far as safety and training and education are concerned, we have a massive database that we've collected over the course of seven years that is usable, not only from the standpoint of training programs, but simply to give to pilots and say here, read it. You'd be amazed how often people will read a report and say "I thought I was the only one that did that". As a matter of fact, I got a letter last week that was a little disturbing. The guy said, "please cancel my subscription to CALLBACK. Every time I read something in it I think 'who could be so dumb to do that', and invariably, within a month, I've done it. So he says, it has to have something to do with his subscribing to CALLBACK, so please cancel the subscription. He was kidding I think!

But the fact of the matter is, the data is there to be used. There is no charge for any of this. If you can use it, don't hesitate to call. If you can't find me, you can find John. If you can't find John or me, you can call RAA, and they can find us. It's there to be used, and I encourage you to use the ASRS data. Don't be bashful. We can work something out. Thank you.

DR. LAUBER: Thank you, Bill. Are there any questions for Bill Reynard? We have one right here.

MR. KOERNER: Norm Koerner, Richards Aviation. You said you didn't identify the aircraft in any of your reports. What about aircraft related problems that may come up?

MR. REYNARD: We see very few of those, and the reason for that is there are other systems that identify hardware problems. Most of the information we have deals with the human element. Now, there are times when we do identify an equipment problem, in which case we will get back to the reporter and outline the ways in which he or she can initiate the curing of the problem internally, or, if after discussion, the reporter would still prefer to remain anonymous, he or she can give permission to contact the appropriate party. Once we've gotten the permission from the person to do that, and they're aware of all the options, then we may go to the manufacturer, but we still don't identify the airline or the person; we simply call up the manufacturer, for instance, and say have you looked at such and such. They have no idea where the information came from. Fortunately, over the period of the last seven years, I think we're nearly in the same category as E.F. Hutton, when we talk, people generally listen.

CAPT. YOCUM: Mike Yocum, Pennsylvania Airlines. Let's assume that I'd like to develop some scenarios, and I'll narrow it down as best I can at the moment that I'd like to examine approach and landing, human factors accidents. Can you give me some examples of how to further categorize this so that you could give me the special search and safety reports on a more specific subject?

MR. REYNARD: Sure. In the first place, you would call me up and we'd talk about it, and we'd define the request on the telephone. You'd tell me what you want to look at and I'd ask you whether you want to limit them to your geographic area, or do you want nationwide data. Do you want to limit them to any category of aircraft? Do you want it limited to IFR or VFR or do you want both. Do you want the data to include ATC involvement or no ATC involvement. Our computer base has become very, very flexible, and we can set up a matrix of whatever issues you want and pretty much respond to that request, but it's a function of sitting down and finding out what it is you want to get at, and once we know what your objective is, then we can start tailoring the request to your needs.

CAPT. YOCUM: It sounds like a dynamic source for scenario design. Thank you.

MR. REYNARD: I'll tell you, we're one of the best kept secrets in the industry

DR LAUBER: Anyone else?

MR. NELSON: Jim Nelson with Dash Air. Bill, what's your phone number?

MR. REYNARD: 415 965-6467. And don't hesitate -- if I'm not there, my secretary usually knows where to find me, and I can get back to you.

DR. FOUSHEE: Bill, I might like to point out since the subject of this workshop is resource management, the database is also an excellent source of that type of information.

MR. REYNARD: To elaborate on what Clay said, we've had several major air carriers come to us who were in the process of putting together resource management programs or line oriented flight training programs to ask for a set of incident reports that they could use to create scenarios for their training environment. To date, we've had feedback from at least three of them, and the data has proven to be very, very useful.

MR. FISCHER: Bob Fischer, Summit Airlines. Bill, in this country, with this kind of a nonattribution approach to what's wrong with the system, maybe we're not getting all the answers, but at least we're getting some of them. What are approaches of other countries such as Great Britain, Germany, et cetera? Do they have more of a "kick ass and take names" approach to this, or are they as open with their information?

MR. REYNARD: They fill the whole spectrum of possibilities. The British have a mandatory reporting system that in the past has been identified as being a little bit of a "kick ass and take names" process that has been modified over the course of the years, and they've found a more constructive approach to human factors research last December when the Civil Aeronautics Authority in Britain instituted what they called CHIRP, I keep forgetting what the acronym means, but it's the British ASRS. The Japanese are starting an ASRS type program through their pilots organization, not through their Government. The Canadians are on the verge of instituting a Canadian ASRS.

Then, of course, you have individual organizations that have incident reporting systems. United Airlines, for instance, has a Flight Safety Awareness program which is incredibly good. We have found that the community is extremely receptive to this concept. Pilots and controllers genuinely give a damn about safety, and they should; they're the ones that are most critically involved. And they really want to be able to talk about it, but they also don't want to hoist themselves on their petard.

DR. LAUBER: Any other questions? Okay. Thanks again, Bill.

DR. LAUBER: I'm on the mailing list for literally dozens of flight safety bulletins and publications from around the world. When any of these come in virtually, without exception they contain material excerpted from CALLBACK and other ASRS material. It's an incredibly inexpensive, readily available source of information that you people can use to put together your own flight safety bulletins, and we encourage you to discuss more of that concept when you get into the working groups this afternoon.

The last formal presentation we have on the program should have come early in the program yesterday. In fact, Lee Bolman presented the lead paper during the 1979 workshop on cockpit resource management that you've heard several references to throughout the course of these proceedings. At that time we collectively were still struggling, I think, with the definition of cockpit resource management and exactly what it meant. I felt to lead that workshop off, it would make good sense to have some presentations which showed some basic approaches to the problem that people could use to tackle and define operationally what we were talking about with cockpit resource management. Lee Bolman's presentation did that in an excellent fashion. I know you're going to enjoy hearing what Lee has to say.

Lee has a Ph.D from Yale University in organizational behavior, and has been a lecturer at the Harvard School of Education since 1972. He's involved in many management consulting activities, and especially since the 1979 workshop with the airline industry in helping define specific cockpit resource management programs. Lee is also the author of a forthcoming book on understanding organizations.

COCKPIT RESOURCE MANAGEMENT
AND THE THEORY OF THE SITUATION

Lee Bolman

Harvard University

DR. BOLMAN: Thank you, John. It is a pleasure to be here. It's the second time that I have addressed an industry conference in the airline industry, and I think I'm not quite as terrified as I was the first time, but I still feel a considerable amount of apprehension. I have several strikes against me. One is that I'm not a pilot. The bulk of my airline experience is the nonsmoking aisle seat and you don't really learn a heck of a lot about flying in that situation.

The second is that the bulk of my cockpit experience has been with major airlines, (Ed Carroll knows a lot about some of that experience) in large airplanes usually with three-man crews. I've had much less experience with the commuter industry. So I hope you will bear that in mind and try to make appropriate translations from the experience I have had to the situations that you know well.

The third strike is that my industry experience has been as a consultant, and that doesn't add to my credibility. Most of you probably are familiar with the definition of a consultant as someone who borrows your watch, tells you the time, and keeps the watch. Some of you may have had the experiences that confirm such impressions.

There should be some points of tangency, and I hope no major contradictions with what Ed Carroll was describing yesterday as he was talking about some ideas that I find helpful in trying to approach the question of cockpit resource management. I suspect that Ed's is more concrete, more practical, as you'd expect from someone with Ed's experience. My approach will be more general and will sound more like a lecture from a college professor.

The way I'd like to begin is to talk about two different kinds of error. Jack was talking about risk, and there's a relationship, I think, between his discussion and what I mean when I talk about error. Error in general has to do with a mismatch between what you want and what you get. There's something we're trying to achieve, and somehow whatever we produce is not what we had in mind. And I want to talk about two different kinds of error, because I think

one is better understood, and our training, in general, does a better job with it.

Error of execution is what happens when you know where you're trying to get and you know pretty much how you're supposed to get there, but somehow there's a lapse in the attempt to produce whatever you have in mind. I had a fair amount of jump seat experience over a few years, and I remember the worst jump seat landing I ever experienced. It was a case of a transitioning co-pilot who had been bumped down from one aircraft to another. He was flying with a check pilot and the conversation between the two of them made it clear that, so far, every landing that he had made had been fairly terrible. As they were on the approach, they reviewed the whole thing again, and the co-pilot said he understood, he knew what he was going to do. He came in too high, too fast, and poorly configured. That's an error of execution. The co-pilot had extensive experience landing airplanes. Presumably he knew how to land the airplane he had transitioned from and was comfortable doing that. With a few more landings, I imagine that he learned how to do well on the new one. He knew what he wanted - he just had trouble making it come out right. That's an error of execution.

Now, there is another kind of error, and that may be less common, but has become more important as we've gotten better at dealing with the first kind. I'll call the second type an error in the theory that you have about the situation. There's an old saying that there is nothing so practical as a good theory. This is not an idea that's widespread outside of the universities, but I think that it contains an important truth. In any situation in life, we act on the basis of our theories about what is going on around us. When I first started looking at what happens in cockpits, I spent a lot of time looking at NTSB accident reports. I still find those to be a fascinating source of information about both flying and human decision making. When I first started looking at them, one of the things I began to notice in a lot of accidents, was that part of the problem was that the crew was trying to put together different pieces of information, various and assorted pieces of data, frequently under situations where they didn't all fit together into some coherent view of what was happening. In many of the accidents, what was happening was not that they solved the problem incorrectly, but they were solving the wrong problem. They had the wrong theory about what was occurring to the airplane. To give you just one example, I think a 727 was lost in a situation where somehow the crew had missed the pitot heater on the checklist. During climb the crew noticed unusually high airspeed readings. I'm going to exaggerate this a little bit, but the crew got into this fascinating conversation about gee, why in the hell are

we going so fast, isn't it amazing? And then they began to develop theories to account for why they're going so fast -- the plane was empty, the weather conditions were unusual and so on. A little later they went into a stall, which they misinterpreted as a mach buffet. If you think you're going very fast when your airplane is going to stall, you don't take the right actions. The crew's actions were right for the problem they thought they had, but they were solving the wrong problem. That can occur in situations where the problem is making sure we've defined the right problem. Once we've defined the right problem, then we go on to the problem of how do we solve it.

Now, it seems to me if we think of this as Type A and Type B, that most of the training that commercial pilots get is around issues of execution, training them to solve the problems that we understand well. And I think well over 90 percent of the situations that pilots encounter are of that nature. It's fairly straightforward. Much of flying is not only routine, but it gets dull. The problems are clear, what needs to be done is clear, it's just a question of knowing how to do it skillfully and professionally. I think our training has done a tremendous job in these areas. It's hard to achieve perfection when you're talking about humans, but we've done well on Type A problems. I think very little of our energy has been on Type B, partially because it's less obvious. It's something that's more obscure and it takes awhile to begin to get a sense of the difference between solving a problem and defining a problem.

So, in my initial efforts to try to understand the issues of cockpit resource management, I came to the idea that pilots are always in the process of developing what I call a theory of the situation. And a theory of the situation is basically a set of ideas that I have in my head that says what's happening right now, what's happening in my airplane, what's happening in the cockpit, what needs to happen under these circumstances. It's that theory about the situation that's going to influence our actions. I'll do what I think is sensible given the conditions.

One thing that I've been trying to understand is when is it most likely that pilot will have the wrong theory -- will be operating under the basis of the wrong assumptions about what is happening. I've been helped in this by some of the reports out of the ASRS system. It's a wonderful database. It seems to me that there's a set of conditions -- major conditions that lead people to get off track. One set of conditions is distraction. There is something happening that is pulling pilots attention away from the critical operational issues. One example that I always remember is the very chatty jump seating captain in the PSA accident at San Diego. While the crew was getting reports

about the possibility of traffic conflicts, there was a captain in the jump seat talking with considerable intensity about the company benefits programs. That could not possibly have been a helpful factor in that situation. It might have been a critical distraction that kept the crew from focusing on more critical operational issues. There has been a series of similar incidents and accidents. Sometimes it's a systems malfunction, sometimes it's in the cockpit, sometimes it's a confusing ATC message. It can even come from the cabin. Something is distracting the crew and making it more difficult for them to function, to do what they really need to be dealing with.

A second set of conditions has to do with stress or high work load. Some of the work that NASA's done in this area makes it very clear that as the work load expands it gets more likely that the work exceeds the capacity of the crew to manage it. The crew gets into trouble, and begins to have the wrong ideas about what's happening.

A third set of conditions I think have to do with Jack's phrase about ignorance and a need to push on. One kind of situation that is often troublesome is where the crew has experienced a fair amount of frustration. One of the clearest examples is delays. I was in an airplane earlier this summer on a day in which I think there were thunderstorms at every airport in the United States. We sat on the ground for almost two hours, and you could tell the captain was getting more and more frustrated. We were going from New York to Dallas, and the weather was bad at both. The guy was getting more and more angry. He finally got a clearance for pushback and he wasn't able to pushback because maintenance was having problems. He was furious because of that. By the time maintenance was ready, ground control had stopped issuing pushback clearances. They asked him was he pushed back, and he said yes, indeed, he certainly was, even though he was still at the gate. The reports suggested that this was a doubtful situation to even take off, what seemed to happen was the right stuff was coming out. This guy's fighter pilot experience was beginning to really take hold, and it was like it didn't matter, what the hell, he was going to get that airplane out of Kennedy and into the air no matter how many lines of thunderstorms there were. It was an interesting experience. It's not that the risk he ran was huge, but he sure as hell was expanding the risk beyond what anybody in the airplane, I think, would have wanted him to do. And I think a lot of it had to do with he had just spent too many hours getting too frustrated and annoyed, and he was going to push on, whatever it took.

Now, a fourth set of conditions is ambiguous or misleading information. That covers a broad range of

circumstances, but it occurs a lot in the aviation situation. Sometimes you get misleading information, like a misleading clearance. Sometimes you have incomplete information, and sometimes you're trying to put together several different pieces of data. You usually can't just simply look out the cockpit window and know everything that you need to know. And you can wind up with a problem as you try to put together all the different pieces of information. A classic example is the TWA accident at Round Hill. They were headed into Dulles and they received an initial approach clearance. The captain looked at his approach chart and said "You know this dumb chart says 3400 to Round Hill." He had a moment of doubt whether to go to 1800 or maintain 3400. But he decided that the controller presumably knew what he said. The crew continued to have a conversation in the cockpit and decided to keep on going down and ran into the mountain. That's one of many situations where the information is either misleading or ambiguous. Whenever you have misleading or ambiguous information, you're faced with uncertainty. If you have uncertainty and you have to take action, then inevitably what you have to do is to develop some way of resolving uncertainty, and you develop a theory that makes sense of it all. If your theory is right, your action will be right; if your theory is wrong, your action will be wrong.

You have a possibility that could happen any time, although it's more likely to happen sometimes than others, that pilots can suddenly get off the wrong track where their theory simply doesn't fit with the reality of the situation. That has implications for how we think about the responsibility that we have in developing effective pilots and developing training that will make them so. And it means in addition to all of the things that we have done in the past to help them learn the operational skills and the systems knowledge and everything else that's critical to a good professional we also face another set of issues that are more difficult to deal with because what we're really talking about here is the residual uncertainty. It's everything that we don't yet understand well. And that includes the unusual set of circumstances, the surprising circumstances, the situation that nobody ever was quite able to anticipate, or all the places where something has gone wrong so now there's uncertainty in the environment and the crew has to find some way to negotiate through that uncertainty. And training programs have really, I think, put little emphasis on how do you train people to deal with uncertainty.

There is a second major factor that contributes, I think, to errors. I was impressed when I first started working with pilots that in certain ways they're just like other managers. The bulk of my work has been working with

managers around how you lead effectively or how do you manage well. I never thought until I looked at it that in some ways what goes on in a cockpit is very parallel, even though in some ways it's very different. And one very significant parallel has to do with one of the most universal phenomena that we have found in working with managers. Let me introduce it with a little story.

This goes back ten years. A colleague of mine was doing a seminar on leadership for chief executives in medium size companies, and we had a group of ten such people who were going to come to a two and a half day seminar on how do you lead medium size companies. And we knew that in working with this kind of group, a very high power, very demanding group, they would come and say, "Show us something good." If it wasn't good, we'd be in trouble. We figured we needed something that would make sense to them, that they would consider was credible and went beyond a few crazy ideas from academicians. So we asked each of them -- each was president of a medium size company -- to send us a tape recording of him leading a meeting. We said you choose the meeting, just give us something that you think is representative of your leadership in your organization. From each of them we got one of these recordings, and we went through them, and we did a little bit of what Bill was saying ASRS does with their reports, we de-identified them. We took out the name of the company, the names of the people, and all of the specifics of a situation, and we made up type scripts, not the whole tape, because an hour's worth of tape is a lot of pages, but we made about 20 and 25 page cases for each of these ten people of excerpts out of the meetings. And we labeled them Case A, Case B, Case C, and so on. They arrived at the conference, they got little loose-leaf binders with these cases in them, they went off to their rooms, and they read them with fascination. It may not sound like the most exciting way to spend an evening, but these guys thought it was terrific. They really just dug into that and read late into the night.

There were a variety of reasons why they were fascinated, a couple of which we hadn't predicted, but we've found since were not unique. One was that in every case where they'd ever met each other they could identify each other's cases. Not all of them knew each other, but a number of them had met through trade groups or conventions and so on. They didn't know each other well, but in every case where they'd ever met, they were able to identify each other's cases.

Query, how did they do that? What do you think? Style is the answer. That is, in every case the individual's management style was like a behavioral footprint, and wherever the person went, you could see that behavioral

footprint and could say "aha this is so and so." In some cases it was dramatically clear -- we had one guy whose way of leading at meetings was blame and kick ass, I guess would be a way of looking at it, or shout and kick ass: "Goddam it, Tommy, you act" -- as he's talking to his vice president -- "you act like I'm asking you to climb Mt. Everest. I'm telling you these are the sales targets and you're going to meet them." So everybody looked at that and said hey, that's Alan, who else would lead a meeting like that. Other cases were more subtle, but what was interesting was that they were able to see it.

Now, if you can do that, what does it tell you? It tells you that there's a tremendous amount of stability in that behavioral footprint, that people's behavioral footprint shows substantial consistency over a period of time, and you can track them. So that was the first thing that was interesting.

The second thing that was interesting was that to a man it was absolutely unanimous after reading all the cases they had this exhilarating feeling that was sort of "Thank God, I produced the one example of effective leadership." They were all sincerely convinced, and at the same time, they were amazed at how bad some of these other guys were. They were thinking, "I'm surprised the company makes money the way this guy leads meetings. How can they ever make a decent decision. This is terrible."

So we did the seminar by going through a case at a time, and for about the first three or four cases, each time we'd start up, the guy who'd present it, would just sort of briefly describe the situation and talk and say a few things about, "Well, as you know, I probably didn't do this quite as well as I could have, but overall I feel pretty good about it." And then he would sit and smile waiting for the compliments to come. And they never came. It took about three or four of those before people began to see that there was a pattern that was establishing itself. Each of the people was hoping for the accolade. He wasn't going to get it.

One of the things that they realized as a result of that seminar was that there was a lot about what they did that was standard, it was absolutely predictable, but the individual didn't know it. That is, they didn't really know about their own leadership style, even though their leadership style was well developed and had been known to others for a long time.

Well, as I've talked to pilots, the same situation, I think, is true. It's as true of airline pilots as it is of other people, that there are a variety of situations in

which we think we know what we're doing and really don't. It is most likely to occur in a couple of conditions. One is when we are under stress. One of the things we know is that when a person is under stress, they are more likely to be doing something that is different from what they think they're doing. A tremendous amount of error under stressful conditions occurs because people simply aren't doing what they thought they were.

Secondly, it's more likely to occur in the more ambiguous, softer, more subjective areas like management style. It's less likely to occur in concrete, easy to define skill areas. So that if you apply that to pilots, what it suggests is that because of the sophistication that pilot training has achieved for many of the basic skills that pilots need to have -- in fact, they know what they're doing. If they don't they find it out every time they go back for the recurrent training. A simulator can tell you a lot about whether or not you're doing what you think you're doing. But when you get into the areas of communications, of resource management, the area of information transfer, of how we take in information and how we communicate information to others around us, the probabilities are much higher that, in fact, pilots are unaware of what they do. Now, this has become critical in a number of both incidents and accidents. One place it shows up is in the large number of cases in which the captain was headed down a particular path. Someone in the cockpit, at least knew, and in some cases tried to give a hint to the captain that maybe the path he was headed down was not the right one. You're probably all familiar with a variety of those, like the accident in Mexico City. The captain tried to land on one runway, and the co-pilot was trying to tell him, "Hey, you're not headed in the right direction." There are many similar accidents. And if you ask why those occur, it's very interesting. If you read accident reports, you find a series of situations in which the captain isn't listening, and frequently the junior crew members aren't talking very clearly, so it's a two-sided situation. The captain isn't really trying very hard to learn what other people have to say, and often they're being very careful or very guarded about what it is they're trying to get through to the captain.

Now, I've talked to a lot of captains about that, and I've talked to a lot of co-pilots about that, and all the ones I've talked to wouldn't make those mistakes. They're absolutely sure they wouldn't do it. In fact, I talked to a lot of captains about their leadership style, and all of them are well above average leaders. I've never run into a below average leader. I've also talked to some of the junior crew members of some of those above average leaders who don't agree that, in fact, they're dealing with an above

average leader. In other cases they do agree. That is, there are cases where the captain's confidence in his own leadership is well validated by the people around him. But one of the things that I've seen repeatedly is cases where the way the captain talks about how he leads, and how he manages the crew is not what I see as I watch him fly, and it's not what his junior crew members see as they watch him fly. And that kind of gap, that inconsistency between what the captain thinks he's doing and particularly how he thinks he's leading is one of the things that produces the problem.

I've talked to a lot of junior crew members about these cases where the captain flew into disaster and the junior crew was kind of shy about bringing it up. Again, the people I've talked to wouldn't let that happen. I mean, they're very, very clear about this. You know, "Hey my ass goes with his, no way I'm going to let that son of a bitch fly me into the ground." And one of the issues that comes up here is well, if nobody would do it, why does it happen? And I think part of why it happens is that in terms of our own perceptions of ourselves, our espoused theory about ourselves, all of us believe that what we would do under those circumstances would be effective. For many of us we're right, and for some of us we're not right. Unless we're given some help somewhere through the training program that we undertake in the course of developing our piloting skills, it may be that we'll never learn for sure until we're in a critical situation, and then it's too late.

That's led me to think that the whole area of cockpit resource management is, in fact, one of the last major frontiers in aviation safety. The kinds of training that we give pilots needs to take account of both of the major issues that I've talked about. One has to do with training pilots to be alert to the possibility that there will be times when you may have the wrong set of assumptions about what is going on, and for them to be alert to a couple of things. One is the clues that maybe you have the wrong theory about what is going on. In most of the cases that I've seen one or both of two clues is present. One is anomaly -- all the information doesn't add up, there's some piece of data that's inconsistent with your view of what's going on. In many of the cases where pilots are operating on the wrong assumptions, there's some kind of anomaly occurring. Another thing is some kind of challenge or at least nudge from other members of the crew that maybe what you're doing is off target. In most of the situations where people have gone off on the wrong program, one or both of those things was present. And in order for that kind of accident to become less common, I think one thing that needs to happen is all pilots need to be more aware that they make mistakes, to get beyond the assumption that to make one is the wrong thing. "I never want anybody to see it, and by

God, if anybody ever tries to tell me that I made one, I'll tell them about what a good pilot I am."

The second is to make it part of standard practice within cockpits that everybody assumes that part of our job is to help each other make sure that we don't do that, and that as a senior crew member in a cockpit, I have an absolute obligation to try to make sure that I utilize any information the junior crew members can provide. As a junior crew member, if I think there is a problem, I have an obligation to make sure that the captain has an opportunity to use that information.

I think that over time it's going to become essential for all of the carriers to develop more objective ways of approaching this issue. The most developed program that I am familiar with is United's effort. I'm probably more independent in this area than Ed is. He and I did not always agree. The program basically has several major elements to it. It began with a home-study course-- a set of written materials for pilots to read. I think that had some degree of utility in getting people familiar with the area, although, as Jack was saying earlier, there is the horse-watering problem. It's a real one here in terms of getting pilots to read very deeply the topic in their spare time. So if you use written material, it needs to be stuff that is interesting enough and attractive enough that they're willing to read it. But that's only a small start, because at most, it can get people thinking differently about the issue.

Part of the problem has been that it's been gradually dawning on many in the industry that the issue is really important. Even in the past year when I've talked to pilots, there are still a number of pilots who are yet to be convinced of the importance. There are far more believers than there were years ago, but there are still some skeptics.

The second part of the program that United developed involved bringing people together in seminars to get them looking at the issues of command and leadership and looking at themselves as commanders and leaders. Participants get feedback from fellow pilots about how they really lead. And I think that's a tremendously useful idea. Not that you have to do it the way United does it, but you need something that gets people into a setting where they work with fellow pilots and look seriously at issues of leadership in the cockpit. How do you make decisions in the cockpit? How can we do that better? And so look seriously at myself and what is my approach to managing the cockpit. I think that's important.

The final part of what United is doing, and I think it's the part that is really critical -- I think you could drop almost anything else, and if you'll do the last part well, that's where the basic learning needs to occur -- is to begin to integrate leadership, command, and resource management into recurrent training, and particularly to bring it into the LOFT scenarios. United's ability to get the pilots to sit still for the video in the simulators was a key step. When people were first talking about it, it wasn't at all clear that that could ever happen. I was so delighted that they were able to develop enough trust between the management and the pilots in that particular situation to convince them that it was going to be used in a way similar to what ASRS is for. That the purpose is not to punish you. The purpose is to convey some information that can be tremendously useful for your learning. More than 95 percent of the situations that occur in an airline cockpit really don't present the key management questions: Do you have the right problem defined? Do you really have the right theory about what's going on? They mostly occur in those very difficult high stress situations.

The nice thing about the simulator is that you can create those same situations where people are most likely to make the kinds of errors that I've been talking about. Those are the situations in which people are most likely not to do what they think they're doing. My favorite example of this is I was watching a crew going through the simulator check, and the captain had been asked had he had much experience with the coupled monitored approach. And he said no, he really hadn't. And the instructor, "You should try it." So the captain and the co-pilot talked about how they were going to do this. "When we reach decision height", said the Captain, I'll either say "go around," or "I've got it." The co-pilot said, "Fine." As they made the approach, everything was going very well. They reached decision height. The captain looked out the window and said, in his best command voice, "Land the airplane." The co-pilot was not expecting that particular instruction -- he knew that wasn't what was supposed to happen, so he looked at the captain. The captain looked back at him. They looked at each other while the simulator continued to descend. Finally the captain said, "Whoops, okay, I've got it." He landed the simulator okay, but it was not exactly how they wanted it to happen.

It was a case in which the captain was absolutely clear in advance about what he was going to do. He said, here's what I'll do, but when he got into the actual situation he didn't do it. Particularly when you have some record of it that the pilots are able to look at, the simulator provides people that opportunity to really see themselves in action in the most difficult situations that they're likely to

encounter.

I think that the set of issues that you're trying to address here are critical. I am always impressed at the difficulties of developing effective approaches to the problem, particularly because of the economic constraints that I have felt are far and away the biggest problem to really do this well. I think we are getting a much better handle on the problem. I think we've learned a tremendous amount about how to better train in these areas, and I think that primarily the thing that gets in the way is to be able to free up enough of the resources so that we can really do the kind of training that's necessary. As Jack was saying earlier, the converse of that same coin is that the costs of an accident are much, much higher; so I think it's worth the investment.

Let me see if there are questions.

DISCUSSION

CAPT. BENTHAM: Jack Bentham, Metro Airlines. Could you go through some of the suggestions that you made to United that they did not include in their program? This is not to critique your United involvement as much as the fact that there are a lot of people in the audience that I think are beginning to formulate their plans and could really use your expertise in your involvement.

DR. BOLMAN: What a great question! I mean that is a good question. There are several different levels. Now some of the ones I threw out, for example, every once in awhile I would write Ed with this great idea for some research that they could do, and I tended to have trouble convincing him of that, that it was going to be expensive and so on. I would guess the major point where we most often disagreed was United had a commitment that was historical to the management grid. A lot of United management had experienced management grid and it made sense to them since the language and the concepts were already very familiar among the United managers. So they chose to introduce that into the flight training situation as well. I always had an uneasiness that the grid people, not the United people, but the grid people had faith that the grid applies everywhere, and that it wasn't always easy to get them to ask, "Wait a minute, are there parts of our theory that maybe don't fit quite as well for the very specialized nature of the aviation cockpit." I thought that United people who worked with them did a tremendous job of educating them. Initially, it was as if they were on

opposite sides of a bridge. The grid people knew a lot about grid, and the United people knew a lot about flying, and for awhile, I think the grid people kept saying, "You come over here and it will all be fine," and the United people said "Wait a minute." So I would guess that that's been the major place where we didn't always agree. I would probably have wanted to massage that theory more than it's been massaged too. There are some aspects of the theory that probably fit fine when you're talking about middle or senior managers in an oil company, but I think the cockpit is special. A lot of those ideas are appropriate, but they really need to be adapted carefully to the specifics of the situation.

CAPT. CARROLL: What Lee has said is absolutely correct, and I think the only explanation I would make in this regard is to carry what he said one step further. We told the people from SMI that what we wanted to use the grid for a frame of reference of the language that was easily identifiable through the population because we were addressing a new area of interest and concern for the pilots. So what we have constantly said and we have been successful, is that we did not want to run a grid seminar, we wanted to run a flight operations cockpit resource management seminar based upon the grid of a frame of reference, a language. As an example, as Lee well points out, we had a history of using the grid in the company, but it runs five and a half days. Ours only runs three and a half, so you can see where you have not emasculated it, but at least we've adapted it to our needs. And to the people who have been through it, both in our company, and I think commercially, I think they would readily identify with what Lee said. We had to cross that bridge and get them to recognize what we were doing and not have a middle management approach. They participate with us in all of the seminars, but credibility of the seminar is, I think, in the hands of the operations people who run the seminar. They're there for theory clarification, but they're really background people to what we're doing, and Lee is absolutely correct. In fact, to give him credit for his disagreement with me -- and it's amazing to get a letter from a Harvard professor and then correct it for him, you know --

DR. BOLMAN: Ed is known around United as the great editor.

CAPT. CARROLL: And I didn't want to be inconsistent with Harvard either. We put out seven books, and Lee has always taken great delight in this. The last one was just reference material, but the first six were the education. We got critiques back from that cross-section of people who studied it for us before we gave it to the whole population, and they said books one to five obviously have been written

by some Harvard egghead, and you ought to throw all that material away, and book six is the only one that really has any credibility. The only one that Lee really had a tremendous input into was book six.

DR. BOLMAN: Some people said that sounded like it was written by somebody who understood the pilot -- the cockpit environment. I do take pride in that to this day. I'm not sure how it happened.

MR. FISCHER: Bob Fischer from Summit. You addressed indirectly the concept of self image that the captain probably has and the first officer and the flight engineer, if it's a three man cockpit. Would you distinguish what we define as the manager versus the leader? I think they're two different things in some cases, and I think our technically qualified captain with numerous years of experience has learned to rely on himself, and basically is a leader. Now we're asking him to be a manager of resources which have always perhaps been there, but suddenly we have a more advanced technological cockpit and we're asking him to be a manager, and maybe he's not prepared to be a manager. Wouldn't he revert back to being a leader under a stressful situation?

DR. BOLMAN: Well, I think certainly he's likely to revert back to whatever he learned earlier. One of the things we know about being under stress is that we tend to revert back to whatever is easiest and learned earliest and we're most comfortable doing. The question -- that is a question that I get asked a lot, and it's, what's the difference between leadership and management? There's a lot written about it and nobody agrees. There's all kinds of definitions of both. Some people give you definitions of both. Some people give you definitions for management that sound like other people's definition of leadership. The way I generally think about it is I think about leadership as the capacity to attract the support and energy of whoever it is I'm trying to lead, to get them moving in the direction that I need to have happen. I think some of the traditional notions of command, which have military history and so on, don't always work effectively as ways of leading in the current environment because there have been cultural changes and people's notions of good leadership are changing. But I think there are also issues of management that go beyond being clear about the management issues. For instance, NASA did a study, the Ruffell-Smith Study -- I don't know if that's been talked about at this program, but they put pilots under high work load situations and one of the things they found was that very often you'd get into situations where the work load was very uneven across the three members of the crew. Now, it's a management task of the captain to solve that problem. And a lot of cases they got into a lot

of trouble in a situation where the captains, under very difficult circumstances, was both flying the plane himself, by hand, (because they didn't have an autopilot,) and making all the decisions, and the co-pilot was sitting there, trying to calculate the fuel dump so that the result was tremendously poor use of the resources. That's a managerial function, I think for the captain to be aware of. My guess is most captains have not been trained in that, and many of them probably aren't very clear about that, about the need to be aware of who's doing what and how do we make sure we're making the best possible use of the resources that we have available.

MR. PITTMAN: Hank Pittman, Reflectone. Isn't there a gray area, isn't there an area where you will actually, let's say, put a niche in the armor or the confidence level of the captain? Is there a point, and have we looked at that point, where perhaps he will over-analyze the situation and not react to make the decision he should have made?

DR. BOLMAN: Yes. That's a tough question, and I don't think I fully know the answer to that. I've been impressed in a tremendous number of the events that I've looked at that there was quite a bit of time to do some analysis, and in the ones I've seen, I can't think of an example where there was too much. I can think of a lot where there was too little, that is, where the crew didn't spend some time that really was available to them to rethink the situation. In a lot of those cases it seems to me what they could have done is try to collect more information from the controller, from the company, from somebody to fill in the missing blanks -- they had blanks in the picture, they weren't quite certain -- it didn't all add up to a coherent picture. I know the concern you're raising. Can the captain become too analytic? Another version of the concern I've heard is, "Can you undermine the authority structure in the cockpit?" And I think that's a real tension. How do you maintain the authority structure so that you have a clear decision-making system when you need it, and at the same time, get away from some of the potential harmful aspects of suppressing suppressing the resource that the junior crew members have. I don't think that's an easy one to deal with. I know the people at United wrestled with that a lot. It gets particularly tricky in issues like when do you take control from a captain. So there are some very tough issues there. My sense is, though, that it is possible to develop a set of understandings about that. If the captain and the co-pilot are both on the same wave length you can begin to get closer to having SOP's for command issues. For instance if the co-pilot thinks there's a problem, he has a responsibility to say so; the captain has certain obligations in terms of how he responds to that, and if they both understand that, and that's become practice for them, they know how to do it,

then I think that problem is less likely to occur. I don't know. If we ever see an accident where it's clear that's occurring, then I'll want to look very hard at that. I guess we probably should look harder at it even sooner than that. It's a good question.

MR. HAMPSON: Brian Hampson, CAE. Have you looked upon this question at all from a National point of view, the National characteristics? In the United States you don't have the rigid class structure which is still apparent in the United Kingdom, and they have the same type of thing in the National characteristics in the Far East where loss of face is a considerable problem you have looked at it from that point of view at all?

DR. BOLMAN: I've thought about it, mostly in the course of reading things like some of the accident reports, for example, of Japan Airlines, and my sense is, you're right, there's a real difference there, and that that difference would need to be factored into any approach dealing with the issues. In some of the Asian carriers I think it makes the problem worse in that it's harder for junior crew members to respond.

ED, do you want to comment on that?

CAPT. CARROLL: I have to compliment the gentleman from CAE for raising that question, because it is something that I have been confronted with just this month. I came back from Japan, and Japan Airlines, as you all know, has had a couple of accidents that have really concerned them. They replaced all of their top flight operations people after the Tokyo Bay accident. They have a new wave of people in there, and part of the new wave is a younger group in their late thirties and early forties who are in management positions now. They speak a little better English, they have a better understanding of the aviation world, and when I met with them for a full day and discussed this for eight hours with them, they asked me what I thought of their culture, and in the grid language, we -- I told them I thought they had a five five culture with a one nine backup. Now for you people that don't know what that means, is it means that they're in a compromising position all the time where no one really has to take a firm position, they arrive at not the best solution, but they get one everybody can buy into, if not commit to, and when all that doesn't work, then they try to be friendly and hurt no one's feelings because everyone will lose face. They accepted that very brief analysis and they also accepted the fact that it does not fit in the cockpit if you're going to have a universal safe approach to things. They are wrestling with their cultural approach as to how to do this, because they recognize that it is a universal problem. And we in this country have it

for all the reasons that Lee has pointed out, but I think these are the kind of things you do have to take a look at, and whether it's culture, whether it's crew size, whatever, it's all still essentially the same problem.

DR. BOLMAN: Thank you, Ed, and thank you all for the opportunity to talk to you.

DR. LAUBER: And thank you again, Lee, for another outstanding presentation.

Well, the time has come for you people to go to work and to take advantage of the ideas and concepts and new ways of thinking about some of the old problems that have been brought to your attention yesterday and this morning. You might view the rest of the day as being an opportunity to augment your own resources in that you have the opportunity to have other people from situations not unlike your own to tackle some of your own problems. What we're trying to achieve with all of this is a series of concrete recommendations, definition of issues, approaches, and identification of resources that are available to help you solve problems that will be assembled as part of the conference proceedings that will serve as a resource book of guidelines that people like yourselves can apply to solving your own particular training problems.

So the real product of this workshop is going to come in the next few hours from your efforts in these working groups. You've all been assigned to working groups. As you know, each working group has a chairman from your industry and a NASA co-chair. We discussed how the working groups will operate and how you're going to attempt to converge on a solution to your problem which is best stated as being able to come up with a good, high quality substantive report which representatives of your group will be presenting when we get together back here tomorrow morning.

Good luck and work hard.

WORKING GROUP REPORTS

DR. LAUBER: We have a couple of people in the audience who were able to join us for the last part of this Workshop, Mr. Walt Luffsey, Associate Administrator for Aviation Standards from the FAA is here, and Alan Stephen from the Regional Airline Association is also able to join us. So we've offered both of them the opportunity to say a few words to you after we've had a chance to hear from each of the working groups. We welcome those people to the Workshop.

I'm very excited about what we're about to hear. I think all of you were working toward the development of some interesting and workable recommendations. I was pleased with the way things were going, with the discussions we heard, so I'm looking forward very much to hearing the reports of the working groups.

We'll go in sequence and hear from each working group in whatever way they have worked decided to present their reports. We'd like to offer ample opportunity for discussion after each working group has made its presentation, so we, again, want to encourage discussion and maybe now is the time when some of the questions that we unfortunately had to cut off on Wednesday can be addressed to the appropriate people.

So with that, I'd like to turn the floor over to Working Group 1. Mike Yocum, from Pennsylvania Airlines, who is the chairman of that group, along with Clay Foushee from NASA, will present their report.

COCKPIT RESOURCE MANAGEMENT TRAINING

Chairman: Mike Yocum, Pennsylvania Airlines

Co-chairman: Clay Foushee, NASA

CAPT. YOCUM: Thank you, John. We found our working group yesterday to be an exciting challenge in resource management in itself. With the size of the group, it turned out that we had too many resources available, and initially that gave us some problems. After the opportunity for everyone to ventilate their ideas somewhat, we actually broke down into two groups and spent a good part of the afternoon researching specific tasks and objectives that we had identified before lunch. It was very interesting when we got together in mid-afternoon to compare notes that these two groups had independently identified a particular method of operation that was entirely different than the objectives that either group had set out to do. So it pretty well indicated to us that we had hit on the key issues. I'm very grateful to Clay for being such an expert at assimilating all of the notes and information that was gathered yesterday, and Clay worked until about 9:00 last evening putting all of this in word processing and attempting to put together a coherent report that I will now ask Clay to deliver.

DR. FOUSHEE: Our group faced an interesting resource management problem. Cockpit resource management is a multifaceted concept involving the effective coordination of many types of resources: aircraft systems, company, air traffic control, equipment, navigational aids, documents, manuals and the list could go on and on. However, the heart of the concept is basically how people function together in a group. I think the majority would agree that most resource management problems boil down to a lack of effective coordination or team work between crew members, or between crew members and flight attendants, dispatchers, air traffic control, or any other people in the system. Now, the reasons for these breakdowns are very often psychological in nature and sometimes from a basic lack of awareness. Humans sometimes don't communicate very effectively. Ego involvement or authoritarian interpersonal styles sometimes inhibit the input of other crew members. Ineffective communication can lead to such destructive circumstances as a breakdown in human relations, and an accompanying lack of openness or sharing of additional information. Increased stress as a result of ineffective task-sharing can result in increased workload downstream and ineffective decision-making.

Of all the major topic areas that our group considered, it all kept coming back to the human element. Now, clearly there are many other parts of the resource management puzzle that could be considered. Resource management certainly includes the management of the hardware in the system as well, but our committee was fundamentally concerned with how we could accomplish -- to borrow a phrase from Stan Fickes of U.S. Air -- "the most bang for your buck."

With this in mind, we felt it more important to concentrate upon the "liveware" or human element in a resource management training program to provide the most positive impact.

We believe very strongly that no resource management program will be effective unless the pilots who enter such a program are already technically qualified as well as emotionally and physically stable. Thus a major assumption of our proposal is that other aspects of a training or selection program must address those particular criteria independently.

The heart of our report deals with how the regional airline industry might implement a program of cockpit resource management designed to deal with human interaction problems in the most cost-effective manner. Our basic approach centers around creating an awareness, in all personnel undergoing such a program, of how subtle factors relating to one's interpersonal style can and do compromise, not only the flight crew interactional process, but all areas of human interaction within a company's operations. Creating this awareness, we believe, is critical to the success of any resource management training program.

We propose that there are three fundamental steps for any operator wishing to create a resource management training program. The first is problem identification; the second, orientation, or initial introduction of the key concepts; and the third we call the implementation or awareness phase. Now before I go into detail about each of these phases, I'd like to address for just a minute an issue that I'm sure concerns everyone here.

Our group was particularly concerned with the issue of limited resources, or as Martin Shearer from Air Midwest said on Wednesday, "I can do anything as long as it doesn't cost any money." So here we are caught in a bind of recommending a concentration on interpersonal or psychologically oriented management training, areas which would seem to require a great deal of outside expertise, and of course, that costs money. We're aware of the apparent paradox and feel that some outside involvement will be necessary for most operators, but we also felt that a great

deal of background work could be done without such assistance, with resources which are available to most companies. We'll elaborate on that as we present our three-phase plan.

The first phase or problem identification phase should begin with a company task force composed of management, training personnel and line pilots to identify what the most pressing issues are within a particular company. This workshop has served as a stimulus for those who have attended to take back information and begin such an exercise within their own companies. You have the raw materials needed. We suggest that a working group framework similar to the one in this Workshop is an excellent and effective method for generating a particular operator's list of priorities. This phase need not involve an outside consultant. The organization, itself, upon careful examination, can do a pretty good job of identifying the fundamental issues.

The second phase is that of orientation or the initial introduction of key concepts to the pilot group. This is the stage where the initial education occurs. Our group felt that a systematic introduction to the issue of cockpit resource management is essential before an actual training program can be implemented. Crew members should be thoroughly introduced to key concepts and encouraged to think about the issue before being placed in a classroom setting. Again, there are a number of resources available to an organization interested in conducting such an orientation program. We suggest that operators take full advantage of such resources as the ASRS database, National Transportation Safety Board Accident Reports, airline incident reports, NASA technical publications, articles in trade publications, and from organizations such as Flight Safety Foundation. Tape-slide and video-tape presentations can be developed and exchanged among member companies. We've seen some excellent examples of this type of work among Regional Airline Association members during the course of this Workshop. For the most part, such information is free, and most, if not all, of the work can be done without the involvement of outside consultants.

The last and most difficult phase, of course, is what we call the implementation phase. This is the area where professional expertise might be required. We felt that any program should include a great deal of work with the role of interpersonal factors in the resource management process. Obviously familiarization with such concepts as the grid, the self-esteem model or any other means of introducing a common language or model of the group interactional process is essential if we're to provide the raw materials which are necessary to create the awareness that we feel is so

important. These raw materials should be provided in a form that is directly translatable to aircraft management and company operations. Thus, the selection of outside experts should consider the consultant's familiarity with such issues. At the very least, companies should provide consultants with some sort of familiarization with aircraft operations. However, this is only part of the process. The concepts are only the raw materials. Individuals undergoing such programs must actually experience directly or have an opportunity to gain firsthand knowledge of small group interaction phenomena if these programs are to produce tangible attitude and behavior changes. Thus, we feel that a resource management training program must provide some means of self-assessment or feedback to an individual about how he or she functions in a group environment.

We believe that the most effective means of providing this feedback is the system utilized by United Airlines where flight crew members view themselves flying a full mission simulated flight. This type of video tape feedback produces objective self-awareness or the opportunity to view one's self from a completely detached perspective, and this type of self-awareness is the most effective known method of producing significant attitude and behavior changes.

Once a program is in place, some means of reinforcement is necessary. "One-shot" seminars stand less of a chance of producing long-lasting results. Thus, it is suggested that recurrent training periodically reintroduce personnel to methods and techniques established during the implementation phase.

We have attempted to present an outline which provides a general framework and summarizes what we feel to be the most important parts of the process and what we feel should be the underlying philosophy for a resource management program developed by each individual operator. However, we felt that there are other alternatives for providing effective cockpit resource management training. We felt that RAA members could capitalize on the expertise and trial and error experience of the large carriers who have implemented cockpit resource management training. We should not get hung up on the "not-invented-here syndrome."

Perhaps the most cost-effective method of providing this training would be accomplished through a pooling of resources among member airlines to create a query program that could be used in whole or in part by a broad spectrum of the member companies. Under the leadership of the RAA, a task force of RAA members could be created to produce such a program, to tailor an already existing program, or at least to help create the raw materials which could be shared among member companies. The RAA might serve as a clearing house

for professional expertise or it might consider negotiating with major airlines for access to appropriate parts of the already existing programs.

Clearly, a preexisting program will not be entirely appropriate or feasible for the average regional airline, just as one single program will not be completely appropriate for all of the regional operators. However, the nucleus of such a program might be provided under such an arrangement, and we feel that this option should be pursued.

In closing, our group would like to emphasize that such an effort cannot possibly succeed unless each operator sits down and takes a systematic look at what will work and what will not work for their specific operation. In this way, they will be in an excellent position to acquire the materials and to get the most "bang for their buck."

DR. LAUBER: Thank you, Mike and Clay. That was an excellent way to start off the morning. At this point let's open the floor to questions and points of discussion with regard to Working Group I's report.

A VOICE: Are you mailing out copies of these reports?

DR. LAUBER: Let me explain the process from here. As you know, we're creating a transcript of the proceedings. We'll use that to draft a preliminary version of the conference proceedings. I will distribute the draft report to each of the industry and NASA chairmen as well as each of the speakers on the formal program for their comments and then we'll get those comments back and incorporate those into the final draft of the report. Ideally we'd send it out to each of you and offer each of you a chance to comment, but clearly that is not feasible. But we do want an opportunity for additional input, further input and editing opportunity by each of the working groups and each of the speakers. So that will be the procedure, and it will take some time to get the report out, but bear with us. We'll do it as quickly as we can.

Do we have any questions or points of discussion?

MR. STEPHEN: Alan Stephen, Regional Airline Association. You assumed a very big opening step which is that the pilot is properly qualified, mentally and physically fit. How important is that, and is that absolutely critical? And obviously there's a qualification process already in place for every airline, but what did you look at separately, or how important is that? Do we need to standardize that before we can go on to the next step?

CAPT. YOCUM: Alan, we considered the basic

qualification to be fundamental to any resource management program, and almost taken for granted, if you will.

DR. FOUSHEE: I might also add that there were discussions dealing with pilot qualification and training in the other groups. They were more directly charged with handling those types of issues. Our major assumption was that, while there may be other parts of the training process that need improvement as well, in order for a resource management training program to really do a very good job, you needed to start with a technically competent and stable pilot. We were not purposely ignoring this area, we hoped it would be dealt with by the other working groups.

MR. PLATT: Russ Platt from Midstate. Did you feel there was any particular group from an airline that you would want to start with first, or did you just want to take a random selection of everybody? I guess today or the day before, Piedmont said that they just went with upgrading captains or captains only or a general mix?

CAPT. YOCUM: As a group, we didn't really address that specific issue. The general feeling that I'm interpreting from the discussion that went on was that we need to provide resource management to all pilots. The basis on which I say that is perhaps the example where we have had accidents where the captain has been the one that's missing the ingredient and the first officer does not advocate his position clearly. Did he have training to provide that insight that he must advocate his position when he perceives the captain as being in error?

MR. BEAUDETTE: Dan Beaudette from the FAA. Please don't let me put words in your mouth, but I think if you would iterate a little bit more on Step 1 of your recommendations it would be more help to each individual company. It may be different for each company to determine what the problem is and where you'd start, and I think from listening to your group that you covered that in Step 1 in making recommendations for each company to get started as to how they want to do this.

CAPT. YOCUM: Yes. The basic awareness program we felt in itself would accomplish a lot towards enhancing resource management in the cockpit.

DR. FOUSHEE: We felt that it was critical that the very first step would be the establishment of a company task force, an appropriate cross-section of the company, which would sit down and actually look at what their specific problems are. This RAA group represents a wide variety of different types of operations, and the problems are not going to be the same for each operation. We felt that it

was critical that each operator identify their needs in great detail. We suggested that the working group framework is an excellent way to accomplish this sort of thing, and that the individuals who have participated in this workshop can take the raw materials that they've been exposed to at this workshop and establish such a task force or working group with their own company. We felt that this process would be the best way to identify significant operational issues within each individual airline.

MR. COLLIE: Dick Collie from the Regional Airline Association. Can you elaborate for the people who were not in your working group what would be the composition of that initial group? I think that is basically what the question was, also, the initial composition of the group within the airline to get this rolling. The mix of management and maybe line pilots, check pilots, just what you perceived as the mix of that group.

DR. FOUSHEE: Do you want to respond to that, Mike?

CAPT. YOCUM: The group felt that a good cross section with a high composition of grass roots line people involved would be the best mix, with enough management people and line check airmen just to keep the program organized and moving. Most of the input being created by the line people would give that sense of involvement on their part, and enhance the enthusiasm and receptiveness of the line pilot body for the program.

DR. FOUSHEE: I think the important thing is to get all perspectives represented within the group.

DR. LAUBER: Do any of the people from Piedmont or U.S. Air or United want to comment on either of those questions, the question of the composition of the initial task force or group within the airline? Does anyone want to offer a comment on that? Stan Fickes.

CAPT. FICKES: First of all, I'd like to compliment you on what you've accomplished. It's really exciting to see how in just three days you're developing a program here, and I know it will move forward. One or two suggestions I might have, I think that it's important to get back with your check airmen and identify the problems that exist. They're much more aware of it than the line personnel. I would recommend that you have a strong foundation, discuss the problems with them, your solutions, your thoughts and so forth before you go to management. If you do that, I think you'll have a lot less problems selling your program, and I think you'll get a lot more support. Thank you.

DR. LAUBER: Thank you, Stan.

MR. BECHER: Ken Becher with Midstate Airlines. How important is having a total program set up before you start the introduction? In other words, can you start introducing people to material before you've got the rest of the program designed, or should everything be totally designed so that the perception isn't that you're introducing something and not carrying through with it?

CAPT. YOCUM: This may not be the right answer, but I'll answer that from personal experience with Pennsylvania Airlines. We embarked on a program of awareness without having any formal program totally intact. We've been following our nose, so to speak, as to where to go in the development of the program, and getting more people involved from the line, and the check airmen, as Stan pointed out, are very much a part of this process. To develop the program and then present it to your people lacks what I feel to be the initial and very necessary ingredient of involvement of the people that it's going to be for. So in answer to your question, my personal opinion would be don't hesitate to launch an initial awareness program, at least, and then have some self-assessment from that point as to where do we go from here, what do we as an airline need. And that seemed to be pretty much the sentiments of our working group yesterday as well, for the method of initial implementation.

DR. LAUBER: Ed Carroll had a comment.

CAPT. CARROLL: I'd like to add to what Stan said and expand upon it just a little bit. First of all, I'm more than amazed that you can put together such a comprehensive expression of a report in such a short period of time. A word processor notwithstanding, it took a lot of effort in order to put that down in the form in which you did, so I think you ought to be complimented for the all-encompassing approach that you took and the expression you made of your deliberations.

As Stan pointed out, your airlines are probably no different in this respect from the standpoint of hierarchy than the bigger one, but you also have, I think, a small enough population where you probably don't have near the problem we did in educating a group of people to the awareness of this situation. But commitment of top management and their awareness either has to be done first or certainly in very close parallel to the outline that you've expressed here, the awareness for the population and the input from the users, if you will. If you had commitment from top management, and that's probably a little bit easier to get, you'll have strength for the program, and it was very important to us that our pilots recognized that there was a continuing management support of the program, so

much so that they asked for management involvement in the actual implementation of the program, the personnel to be used. But I would echo-- I was going to make a comment a little broader, but what you just responded to, Mike, in the previous question I think is extremely important. The users must be in on the ground floor of the development of the material, because this is a new approach that you're going to take. They're used to technical training, but they're not used to this kind of approach, and they had best understand from the very beginning that it is a support expression on your part to try and create an even more professional atmosphere than you had before. I would just encourage that you go up front with the fact that this is not an evaluative program, but a supportive training tool, and make sure that when you do get to any implementation questions, that grading forms, assessment forms or evaluations or any words of that type, are eliminated from your vocabulary as you approach the development of the program.

DR. LAUBER: Thank you, Ed.

DR. BENTHAM: Jack Bentham from Metro Airlines. I'm responding to the question over here about a developmental plan for your cockpit resource management. What we did at Metro to prepare upper level management for budgetary requirements is to present to them a three-year strategic developmental plan, and included in that was the cost effectiveness of the program, specific items as to the pay-back and return on investment issues for the executives. It also began to show them how the pilot involvement would occur, and what would be the ultimate pay-back as far as cost efficiencies as far as reduction of fuel costs, savings from maintenance costs by teaching the pilots to be key decision-makers, to be executive managers. So one of the suggestions that I would throw out for consideration is the actual preparation of the three- to four-year strategy development plan to include budgetary requirements, to include an education process of the upper level management, to include the board of directors, if you have access to them, to include the pilot association, to include a steering committee that is composed of your pilots, of your upper level management, of ALPA, of other people that might be in this particular process. And by developing this three-year plan, you've actually prepared for budgetary considerations in the second year and the third year. And you might find that the biggest bang for your buck may be that in planning this developmental program, you may end up with more bucks for your particular program. So I just throw that out as a consideration.

DR. LAUBER: Okay. Thank you. Any others? I, like Ed Carroll, was amazed of the quality and detail and quantity

of the report. It was clear that somebody worked hard and long yesterday. Thank you very much, gentlemen.

With that, we'll turn the floor over to Working Group II which dealt with the issues of simulation and flight crew training. The industry chairman for that is Frank Foster from Ransome Airlines and Bob Randle from NASA is the co-chairman of that group.

SIMULATION

Chairman: Frank Foster, Ransome Airlines
Co-chairman: Robert Randle, NASA

CAPT. FOSTER: The simulation working group followed the suggested discussion items listed in the symposium program, to wit: what simulation resources are available, what are the advantages, disadvantages, and shortcomings of simulators, how can simulators be used in cockpit resources management training (CRMT) by the small air carriers, and what research is needed to further develop simulation technology and the application of simulation in regional airline training programs? These are wide ranging topics and the group was hard-pressed to focus their discussion in view of the diversity of considerations that could and did arise. They ranged from all the problems with simulator specification, procurement, validation and use that have plagued the major air carriers over several decades to new problems related to the large diversity of aircraft, locale, and corporate size and operating style of the many regional airlines.

Many participants had little experience with the typical full-blown, motion-based training simulator utilized by the majors and the military services. However, there was sufficient expertise in the group for the purposes at hand and it soon became apparent that the overriding issues were not in simulation technology or training technology but in the prohibitive costs of sophisticated simulators and thus their very restricted availability to the regional airlines (RA). This led to a discussion of communal training facilities and cost sharing; fixed-based, non-visual simulators at affordable cost; and other training devices such as the use of hangared aircraft.

Two underlying themes were frequently articulated during these discussions: (1) The terminology used by the FAA in describing training apparatus was less than helpful. For instance, a fixed-base simulator is not a simulator but is to be referred to as a "training device". Thus a full-mission, motion-based simulator is a simulator, not a training device by exclusion. This arbitrary manipulation of semantics is difficult for the uninitiated and is unrealistic since it leads to an unproductive dichotomy of training apparatus into training devices and aircraft surrogates. (2) Never has it been more critical that a systems approach (logical) be taken in the specification of training media, whatever form they may eventually take, particularly large hardware items. The RA's do not have the

capital resources that the larger airlines have so must be in a position to buy only that which is necessary and sufficient to support their training goals and meet FAR's. The approach to training media specification must proceed from molar training needs to functional training requirements to hardware and software specification, i.e., from job elements to task elements to skill elements to device design. No costly "bells and whistle be included that do not contribute to the training goals.

The working group discussed the advantages and disadvantages of simulators for RA training. They were substantially similar to those for all airlines:

Advantages:

1. The safety involved in training in a simulator is both obvious and well established. Not only are training aircraft accidents reduced but very dangerous emergency operating procedures may be practiced safely and repetitively.
2. Given good preventive maintenance support they are reliable and available for scheduling training at any time.
3. They provide FAA-acceptable training and checking without having to use the aircraft. Their acceptability is increasing as is shown by the recent Part 121 rule allowing transition training to be accomplished with zero aircraft time.
4. They provide a good context for LOFT and Cockpit Resource Management Training (CRMT) in which realistic contingencies can be practiced and checked while observing crew interaction, procedures, decision-making, etc.
5. They are extremely cost effective when compared with aircraft training.
6. Training efficiency is considerably enhanced and standardization of procedures can reach a high level of excellence.
7. Related to the previous point, the development, practice, and evaluation of SOP and EOP is considerably facilitated.
8. Aircraft guidance and control procedures may be practiced safely under both normal and contingency environmental circumstances. These include, for instance, instrument flight procedures in severe

crosswinds and shears, and all categories of runway visual ranges and meteorological conditions.

9. They are also extremely valuable in new-hire evaluation, remedial training for slipping pilots, and, probably most importantly for the small airlines, can be partly amortized by contracted training to other users.

Limitations:

1. In some cases not all FAR related check credits are available.
2. Achieving simulator fidelity in its dynamic response is always troublesome because of difficulties in acquiring valid aircraft aerodynamic response data packages and further problems with their implementation and checkout.
3. There is always a problem with trainee acceptance of simulator training in lieu of aircraft training. This is mainly an initial response which, in most cases, fades with further trainee experience with the simulator as an integral part of the training program.
4. The compatability of the simulator with other elements of the overall training program is essential and is not always obvious, particularly when the aircraft itself is the major training device, as it usually is with the RA's.

Disadvantages:

1. In the case of the RA's the overwhelming disadvantage is the high initial cost of an aircraft-specific, full-blown simulator.
2. If the simulator is not bought outright but is shared with other users then accessibility, proximity, and availability may be areas of considerable problems.
3. The simulator must be housed in a simulator facility and it must be supported by appropriate technical and training personnel. This is a source of considerable cost and organizational planning and effort and would be crucial for small operators.

The working group considered the use of simulators in CRMT and recalled the many forms that that training has taken as evidenced by the content of the formal presentations in the symposium general assembly. It was acknowledged that this kind of training is given in sometimes very primitive simulations such as seating the Captain and First Officer next to each other in two chairs

and having a go at role playing. It is probably true that CRMT, like more conventional training, has to be phased, going from knowledge and information to part-task practice to full-blown crew interaction in a realistic cockpit with substantive scenarios. It was therefore agreed that simplistic simulations had a place in the scheme of things but were not within the purview of this working group.

The simulator was seen to be crucial to a qualitative CRMT program. The goal of CRMT is to instill attitudes and personal styles vis-a-vis colleagues that are conducive to good utilization of all the cockpit resources available to the crew. When these are not necessarily present but are trained into individuals then the question arises as to how deeply they have been ingrained. Individuals under stress are well-known to revert to primitive or "first-learned" forms of behavior. Behavioral modes only recently acquired will be the first to disappear. The simulator can provide the full context of operational contingencies and "stress" within which the tenacity of the new behaviors can be both exercised and assessed.

Related to the question of the durability of the CRMT is the need to provide for and encourage a pervasive awareness of CRM throughout the aircrew, training, and management complement. Line-oriented flight training (LOFT) offers a natural vehicle for the promotion and maintenance of this awareness and also for the CRMT itself. It would thus be a recommendation of the group that CRMT be made a part of LOFT.

It was felt that it was not necessary that the RA'S use a motion-based, full mission simulator for CRMT but that a necessary and sufficient device could be an alternative to a communal training facility. The training that would be possible in this device would be:

1. CRMT and LOFT
2. Normal, abnormal, and emergency operating procedures
3. Instrument proficiency, approaches, navigation
4. Systems operation
5. Transition, upgrade, and differences training
6. Some airman certification and FAA credit

Other alternatives need to be explored; finding other options is a worthwhile area of future technology exploration. One new development that appears to have a

great deal of promise as a solution to the peculiar problems of the RA's is the Rediffusion TRIAD III imbedded simulation approach. In this the real aircraft is used. The aircraft plugs into a computer which plugs into a three-screen projected visual scene. The aircraft equations of motion are programmed in the computer and the aircraft is flown like a simulator with all instrument indications responding as in the real world. Initial R&D costs have been high, but in volume production, it could compete with fixed-base simulations. Also, if cost sharing were to be utilized, it would be an even more appealing alternative.

MR. NELSON: Jim Nelson with Dash Air. The question that I have specifically and maybe someone in your group could give me some information on is how to approach FAA check credit for certain maneuvers with a ground training device in our training program, and after going through a lot of tedious back and forthness with our FAA office, we really didn't get any credit to speak of in the way of checking airmen. And I wonder what approach you can suggest to this. What our FAA gave as a basis for the limitation was a publication that the FAA had put out on simulators and ground training devices. And that was really about as far as it got. And I'm wondering if any of the operators have actually gotten some sort of check credit for instrument approaches, for instance, and what I could plan to do to implement some of those credits if, in fact, they have been granted.

CAPT. FOSTER: You grab the microphone, Dick. Maybe you can better answer that.

MR. COLLIE: I'm Dick Collie with the Regional Airline Association. Let me give it a try, because the Regional Airline Association for the last six months has had a committee working on this very thing, to ascertain what we could do to upgrade the level of training devices. We have made the FAA aware of what we are trying to do and what we think should be the end result of our efforts. We have formed a working committee, composed of representatives from simulator manufacturers, three industry representatives, one each from Metro, Air Midwest and Scenic Airlines, and initially we had FAA participation. However, for the last three or four meetings, we have not had any FAA participation.

We have decided that we wanted to do something that's never been done before. We wanted to establish some performance parameters and tolerances for training devices, because, as the gentlemen said there are none right now. As a result, the FAA through its internal directives, only grants, regardless of the sophistication of the training device, a nonprecision approach for checking credit. There

may be some airlines that have more checking credit, or who have less checking credit, be that as it may, that's what the FAA directives say.

We've decided to look at all dynamic training devices and categorize those devices into a Level I training device, Level II training device and Level III training device. To make a long story short, the Level III training device would be a fixed base simulator that would meet the requirements of Advisory Circular 120-40 and that will make Ed Fell happy.

It will meet all the requirements of 120-40, the latest Advisory Circular on advanced simulation, except that we left out some of performance text required under lateral and longitudinal stability, such as dutch roll dynamics, stall stability and text of this nature that drive the cost of the device up to the point where it would no longer be cost effective.

We are going to justify what we have done and, present the package to the FAA and ask them to consider granting certain checking credits if you use this device. We hope this device will be priced at less than a million dollars. We may be overly optimistic, but there's no question in my mind, that the Level III Device can be brought into the market place for less than a million and a half dollars. We're talking about hydraulic control loading, not about pulleys and cables. We're talking about a good machine that will faithfully reproduce the airplane and do what it is supposed to do. It doesn't have motion or visual. It would be adaptable to motion.

The Level III training device would then be a replica of the airplane. We use the word replica instead of a duplicate, simply because we didn't want to drive the cost up by specifying actual control columns, seats, from the airplane. We wanted it to replicate the airplane rather than duplicate it. There's a big difference in the cost.

The Level II device would be a device which would approximate an airplane using off-the-shelf hardware. The cost of this device would be drastically reduced. A good example is the ATC-810 device at Scenic. This device was built to resemble a PA 31 and was converted to be representative of Cessna 402's and 404's. As a result it's been very effectively used in Scenic's program. They still only get a nonprecision approach for checking credit.

The level II device would use the aero package for a specific make and model airplane, not a class of airplanes. It would not have the fidelity of the Level III Device, because it would not be an exact replica of the cockpit but

it would have all the functions. You would be able to accomplish normal and abnormal emergency procedures, and LOFT training. It would do everything that the Level III would do except that the instruments might not be in exactly the same position.

Then we take the generic device, the Level I device which basically is an instrument trainer that you can use as a procedures trainer, you would get very limited credit for this level device. It's interesting that our task group elected to use the simulator requirements that were in effect before the advanced simulation program for the level I & II training device.

I'm sorry I took up so much time, but that's what we're doing, and we should have that package ready to go to the FAA within the next 45 to 60 days.

DR. LAUBER: Thank you, Dick. Any other questions or comments?

MR. HAMPSON: Brian Hampson, CAE. It's just a comment or a series of comments I want to make. First of all, it may be of interest for some of you to know that the civil aviation authority in the United Kingdom are presently reviewing requirements for simulator approvals, and on a draft document called CAP-453, they are looking at the approval of all sorts of training devices, not just simulators. There's a working party working on that in England at the moment, and you might find there's some spinoff for you there.

The next thing I wanted to say was that we talked about this \$7 million simulator, and that is a simulator which represents a wide-bodied jet, possibly with an advanced cockpit layout, flight management system, and so forth. It is not necessary for the type of simulator that you want to think of in those terms. A breakdown of the prices -- one obviously can't be specific here -- but the breakdown of prices of that \$7 million, about half of it is accounted by the motion system, the visual system and the aircraft components. A simulator which we built quite recently, the cost of the aircraft instruments and avionics and aircraft parts was greater than the total cost of the previous simulator bought by that company.

So this is an area where we should be looking, I think, to see if we can use simulated instruments or surrogate devices to take the place of the avionics components in modern aircraft.

The third thing that I wanted to talk about was the Triad concept. It's something which we in our group

discussed as well, and here, as in the case of many other areas of aviation, what we need is more cooperation between the various groups of the industry. The Triad simulator has for general commercial use at the moment one drawback, and that is one needs to modify the aircraft in order to make the system work. But this could very easily be changed if the avionics industry as a whole planned for the training requirement when they were designing their avionic units. It's a much easier task in the design of the avionic units to bring out circuits to a plug or socket on the external part of the box rather than sometime later have to modify, and we all know the problems involved in modifying aircraft instruments, modifying boxes with respect to certification of them.

The need for the avionics manufacturers to recognize the training requirements I believe is paramount. We are finding in the Phase III simulators that the big airlines are buying -- and, in fact, the Phase II simulators -- that sophisticated flight management systems and triplex system for training pilots and this type of thing are restricting the ability of the simulator to be used in its normal role. If you put the black box out of the aircraft, you immediately find that you have problems in repositioning the simulator because the black box was never designed on the airplane to enable rapid repositioning. The same sort of thing is seen with other simulator attributes such as speedup or slowdown or record and replay. None of these things can be done if you use the black box as designed at the moment. I know that the Boeing Company and the simulator manufacturers and some of the airlines have been putting pressure upon the avionics manufacturers to take these requirements into account when they design the equipment to with. I think that we all should be putting pressure on them.

DR. LAUBER: Ed Carroll?

CAPT. CARROLL: I think it's more in the line of a comment. Frank, the expression that you used or the indication you gave about a cooperative approach is one I would encourage probably in all areas of this training whether it's the kind of thing they're talking on the Triad or whatever. Anything you do in a cooperative sense will minimize the need for your manpower and your resources to be used. I think drawing the example from the bigger carriers, one of the big mistakes that they've made over the years is that they've all established their own training centers, and, therefore, they have a duplication of equipment, staffing and so on. I would think in light of what's taken place in the industry today, they might have to reassess that in years to come and see if they shouldn't go to a centralized approach, themselves. So I would encourage,

before you make the same mistakes that the bigger ones have made as they've gone along, is that you encourage as much as you can in the way of cooperation regionally so that you don't have to travel from east to west to get it done, whatever the name of that town was that you used.

The other comment I would like to make at the risk of telling Dick Collie and his task force that maybe they should start all over again is that my experience with the FAA has been very, very good from the standpoint of if you bring them an intelligent proposal they're not hide-bound to all the regulations that have existed in the past, but they're willing to listen to a new approach. I'm afraid I sense a little bit of what I just heard from Dick, which is a lot of good work, but I think it's based upon a concept that we have had in the past that you must have a Phase I, Phase II, Phase III approach. Perhaps that's not necessarily true when you take an industry of your type to where if you do it on a cooperative basis and you have individual concerns of what has to be done, that maybe you can go to them and say this is what we intend to accomplish with this particular approach. If anything, just take most of it out of the airplane rather than all of it out of the airplane. I think you might find that they're receptive because their approach has always been greater safety and efficiency as far as the pilots are concerned and the population for environmental protection, et cetera. I don't think they'd ever be hide-bound to regulations that exist right now or something in the past that they based things on and that you therefore had to perpetuate that same approach. That's what I think I sense. I might be wrong, but that's the first impression I get. I would encourage, perhaps an individual and novel approach rather than looking at past history.

DR. LAUBER: Thank you Ed. Any other questions or comments?

I, like Ed, think that one of the key things that you people identified in your discussions yesterday was the notion of pooling your individual and limited resources in order to take advantage of what otherwise might be unavailable to you as individual airlines. I think that's an important direction to take for your industry. Thank you very much.

The third working group dealt with similar issues, and specifically, they were directed to focus on the question of low cost training aids and devices. Clearly there's going to be some overlap between the two working groups, but I'm always amazed at how little overlap there actually is. The industry chairman for Working Group III is Jim Lawver from Scenic Airlines and Al Lee from NASA was his co-chairman.

LOW COST TRAINING AIDS AND DEVICES

Chairman: Jim Lawver, Scenic Airlines

Co-chairman: Al Lee, NASA

CAPT. LAWVER: You all know Al Lee from NASA. I'd like to introduce David Schober from Command Airways. We brought him down for moral support. He's one of the users like myself. We had a good active discussion. Some was productive, some was nonproductive. Participation from everybody was, I felt, very encouraging. The feeling that something needs to be done is certainly there. It was discouraging because of the fact that there isn't that much out there to work with. If you're a light twin operator like myself, (we fly 402's, 404's, as I mentioned the other day, plus the Twin Otter) there's quite a bit to look at. I just might run through a quick list and kind of pop your eyes a little bit on the prices. The ATC-810, which I mentioned the other day, satisfies training needs for people like myself, 402, 404 drivers and Navaho Chieftan users and can be adapted for any light twin operator generally speaking. We do get credit -- for a VOR approach. We do not have a requirement for NDB approaches.

The AST, Aviation Simulation Technology, (we have a rep here, Dominic Marro,) offers a generic, light twin training device. That's somewhere in the fifty to eighty thousand dollar category. Our ATC-810 is somewhere in the \$40,000 category. Flightmatic Incorporated out of Teterboro, N.J. offers a light twin engine model for about \$40,000. They also have what they call an F-209 which simulates the Cessna 421. The 209 offers turbo charged engine instrumentation and cabin pressurization controls and a wide variety of failure modes for virtually any type of emergency situation, plus visual display, \$80,000. Frasca International, has a piston light twin trainer, \$65,000. They also have a turbo prop fixed wing trainer that starts at \$275,000. The price gets increasingly frightening here as the complexity increases. Singer Link, we also have Dave Baumgart with us on our panel. As many of you know that company built the lunar landing simulators, and \$6 million 747's giant simulators. They also produce training devices. They have a GAT-2 twin engine mode. It sells for approximately \$500,000. There's an outfit in Cupertino, California called IFR Flight Synthetics, and they, as I understand, buy old GAT trainers and refurbish them and sell them. They offer a full motion three-axis twin engine machine available with dual controls, priced at \$67,000.

So that will give you a little idea of what's out there from that standpoint. The problem is -- I guess it's

obvious -- that there's a large gap from there on up to the fancy high-priced simulators that we discussed earlier. So that was, of course, a concern, since many of the regional airlines fly the more sophisticated airplanes.

In addition to some discussion on that, we talked about other aids and devices, and some of them have been mentioned already, such as audio-visual slides that can be produced relatively cheaply, or random access video disk type -- Frank or somebody mentioned that -- programmed instruction and video cameras. Somebody brought up that you probably could use that for preflight walk-arounds, especially when aircraft aren't readily available except very late at night. Mockups of course are a good idea. You can gain a lot through scan development, normal emergency procedures, identifying and locating switches, this type of thing, and there are some mockups that individual regional airlines have made on their own. A point was brought up, and I think it was a good one, that training aids like that, mockups, have got to be realistic enough to motivate the pilot or the crew to get something out of it. There's a real problem there with boredom, and if you don't make it realistic enough, then the pilot is probably not going to get too much out of it. And, of course, a good instructor is valuable there if you can afford one.

A recommendation: we need a library or a source fact sheet list of just what audio-visual techniques and materials are available. I'd like to be able to pick up a piece of paper, a fact sheet and say okay, these are available if I'm flying this type of airplane, or what else is out there that other people have come across. And I think maybe some additional research along those lines would be helpful. And I hate to keep suggesting RAA, but I'll say RAA and NASA because these guys have been so good to us. They've really been a big help.

Interactive training systems were discussed, computer-assisted instruction, photo mockups with CRT's, a little more involved touch panels. Highly flexible-type systems reduce instructor time, so you could probably almost afford to buy it, or at least to invest in it.

A recommendation here, is a pooling of resources, which is an excellent idea. We can't afford to go out and buy and to invest in many of these devices, but through joint use, through RAA and possibly NASA, maybe we could pool our efforts and come up with some aids and devices that we could all use. It's going to be difficult obviously with the variety of airplanes that are out there. I think maybe we're fortunate in that we are still basically flying a light twin airplane, and we're satisfied with what we have in the ATC-810.

We discussed tape presentations similar to those developed by Mike Yocum at Pennsylvania Air and Frank Foster of Ransome. We'd like to see just how that program went, and we'd like to see it sometime, Mike, if that's possible at a later date. Maybe through RAA we could have something like that made available.

We talked about Instructional Systems Development (ISD), and about the need for guidelines for this type of device. I have a little note down here: fidelity needed, and trainers require skill and task analysis. Maybe Al would like to pursue that a little bit more.

Resource management: we got a little too tied up on nuts and bolts, and then we decided we over killed that one, and returned to a more general discussion of resource management. Again it was apparent that many of the group just didn't have any idea what was available even from the education awareness program. So, again, I think it would be helpful if we had a list, something you could take and say okay, these things are available. I know in my presentation I mentioned a library of sources, Mike Yocum mentioned a couple things I hadn't even found, and Frank Foster the same way, and we were all on the same resource management committee. I think if we can get, again, a sort of fact sheet of all these things, then, the individual airlines could look and say yes, that looks like something I could use and maybe have a good starting point from there.

Information transfer: we talked about that among operators concerning training problems and solutions. It's difficult when you get together in groups like this, because when you leave you go back to the real world and you've got all this paper work that's been growing for the last three days, and it's hard, then, to get yourself -- well, you get yourself involved with the day-to-day activities, forget all the good stuff we talked about here. I think we need some kind of continuing effort along this line. I don't know if a newsletter or other media would be possible, but at least more get-togethers, either in a seminar-type format or even a working group. I thought that this workshop was certainly helpful.

I want to thank Lee for his help and all the others for their help in our working group. One other comment that Frank made that we talked about, too, is that we have to identify what we need. We talked to the folks there from the two manufacturers of training devices, and they said, tell us what you need and then maybe we can go from there. Just one last observation, this is not a war story, but the old business of tell me what you need and we'll try to build it reminds me of when I was in the Air Force flying jet fighters. Many times when there was a new airplane

developed and built, the first time the poor operator/user got to see it was when he walked out the operations squadron building and some guy from Air Force Systems Command up and said there are your 24 new tactical fighters. And so you go out and get in it and all the weapons switches are under the seat, and the gun sight is pointed in the wrong direction -- not quite that bad. However, in the early days of the Air Force -- and this hasn't been too long ago -- the Systems Command and the manufacturer got together to develop the system, and then gave it to the user without any contact with the user at all, and that turned into several disasters, as you probably know. But finally through Tactical Air Command and some of the other operational users we did actually get into the early development of a new system. We said, okay, we'd like to have this or that, and they actually listened to us, and we became involved in the initial development with the manufacturer and with the Systems Command. The Systems Command did their routine, the systems development test and evaluation, which I'm sure some of you are familiar with; then we did our operational testing and evaluation, and not until that time when it was fully tested, fully operational, did we accept it on the line and put it to operational use on the gunnery range or such places as Southeast Asia. This is a much better approach than suddenly having an airplane sitting out there on the ramp and trying to figure out, well, what are we going to do with that one.

So I think the effort here is going along those lines. We're actually talking to each other. We've got to tell them what our objectives are. It's difficult for them to build something out of it.

DR. LAUBER: Thank you, Jim.

Are there questions or points of discussion with regard to the things we've just heard from Working Group III?

MR. BECHER: Ken Becher, Midwest Airlines. I can't agree with you more on need in all of these areas for some kind of clearing house where we can go to get information on what's available. So often we don't have the time to do it on our own. An example is we've been approved for 700 RVR takeoffs. Now, we've come up with a problem of how do we give pilots a realistic idea of what is a 700 RVR takeoff?

We found an article in an Aviation Convention News from July on a device that's a pair of goggles, and it's got a little black box, and the operator of the black box can control RVR -- I don't know how, but he moves this little lever and it adjust what the pilot can see. But we have no source of information to go to. It was just luck that we found this. We don't know its effectiveness. We're looking

into it, but a clearing house of some kind of information would definitely be useful, and that's probably as much of an educational process of people who are manufacturing items as it is what we can do.

DR LAUBER: Do you want to comment on that?

CAPT. LAWVER: Well, I haven't heard of that particular device, but your point is certainly well taken.

MR. COLLIE: John, it's some company in the Carolinas, I've been in contact with them a couple of times, and they were supposed to send Air Wisconsin and Ransome a prototype for testing. I still have their phone number. I'll check with them and see where the program is at.

DR. LAUBER: Dick, I thought you might want to respond to the generic issue raised by the comment, and that is this whole function of a clearing house and the importance of that. I couldn't agree more that that kind of function is important to an industry as diverse as your own. To some extent, NASA can function as a clearing house. That's what we're doing with this kind of meeting. But, clearly, NASA does not get involved generally in long-term operational programs of that kind, and this may be a role that your trade associations or organizations like Flight Safety Foundation could play, and I suspect we'll hear more comments on the fact when we hear from the next working group.

Dick Norman in the back has a question and/or comment.

CAPT. NORMAN: Gentlemen, as I sit in and observe the proceedings in progress right now and on the membership of one of the committees here in Group I with Mike, it's very evident here of RAA members, the presentation that Dick Collie gave and what he's trying to present here in the way of simulation -- I'm an advocate of advanced simulation. I worked with Dick while he was in office at FAA, Charlie Huettner and Ken Hunt and the rest of the people to expand this for the major airlines. The cost factors are so great in that area, it takes the major carriers to afford it. Your RAA members are unable to do this. We recognize this. The economic impact is too much. So I certainly advocate what Dick is offering here, that the RAA can work together as far as getting something for the group as a whole. I want to state here, too, that as chairman of the Pilot Training committee I'd be glad to, and our committee would be glad to assist them in what we can in information and considerations as far as simulation is concerned, and in training devices. It's a need, you people need this, you're in the air space with everyone, and the training is so important and so is the safety factor. I want to make that statement to you and

make that offer to you, too.

DR. LAUBER: Thank you, Dick. In having personally worked closely for the past several years with the ALPA Pilot Training Committee, I know that Dick and his people are indeed capable of really doing some good work and have done so in the past. I think it's an interesting offer.

Do we have other questions or comments for this group? Yes, we have one back here.

MR. DEREN: James Deren from Air Kentucky. Small commuters usually, you know, they can't afford either \$80,000 or \$40,000 for a training device, but we at Air Kentucky happen to use both kinds. We use the 810 and also the AST 300. How we do this is one FBO has an 810 that we rent, forty bucks an hour, also there's a company in Nashville where all the guy does is run a simulator company utilizing the AST 300. And what it costs us to keep our pilots -- do recurrent training with the devices is a lot cheaper than we could even make payments on having one of the devices. And a lot of the small airlines need to look into or investigate to see if one is in your area and adapt your training program around it. And whether or not the FAA gives you credit for being able to shoot an approach, it really doesn't affect us too much. I can knock three or four hours off upgrade training in the Beech 99 by putting my pilot in the simulator and doing the maneuvers in it. Whether you're trying to teach a guy how to do a ADF approach, which we end up doing every six months, that's the only time he ever does one, running through 90 gallons of kerosene an hour or just sitting in the simulator, I mean, what's the effect? So I can knock off a little bit of flying time by use of the device whether I get credit for it or not. So it does have its positive aspects.

CAPT. LAWVER: Yes, that's a good point. We farm out time on our trainer to other operators, too, so that's a good way or a good approach when you're limited with money like all of us are.

DR. LAUBER: There's a hand back there.

MR. BLOOM: Bob Bloom with Imperial. One thing that we've kind of gone round and around about and we've pulled out of the loop are the aircraft manufacturers in developing simulators and cockpit procedure trainers. We've just ended up taking an order on two 360's and a whole bunch of stores. I'm wondering if we had it to do all over again if we brought pressure upon the manufacturer to work with people like the ATC people, like the Link people, to say along with the package that we're buying three, four and a half million dollar airplanes, we want, you know, a procedures trainer

and use that as leverage. That economic leverage makes a hell of a lot more sense when you talk about the initial outlay of sixteen or seventeen million dollars. And I think right now what we're faced with is now that we have the airplanes, now, what are we going to do about reducing the training costs and increasing the safety by using a procedure trainer. The next time your boss calls you into the office and says we're going to look at the ATR 42 and we're looking real close, you might want to keep that in mind and talk to those people and say, hey, what can you do for us for training in terms of simulation.

The other thing is in defense of Dick Collie's Phase I, Phase II, Phase III trainers, there's a lot of operators that can't afford the two or three phase and have to go with the one phase, and it sounds like it's a band-aid approach, but I think it's a foot in the door to get people to look at it and start to use it and then you can phase into those other trainers.

DR. LAUBER: Other comments or questions? You want to respond to that in any way?

CAPT. LAWVER: I think we still have two training device manufacturers here. I thought maybe they might want to say something. Do we have Dave Baumgart from Singer here?

DR. LAUBER: Would you like to comment?

MR. BAUMGART: Yes. Dave Baumgart from Link. Link has, as probably a lot of you know, traditionally developed simulators for probably the larger major carriers, and as such, we're probably on the high priced end compared to the type of devices that would be attractive to regional carriers. I think one of the things we need to keep in mind, and we discussed it yesterday in our group, are devices that would have value for training as opposed to devices which are suitable for the FAA for the checking requirements.

The FAA traditionally, and still today, is very high on the realistic side of the scale in order for them to take a device and give evaluations, type ratings, proficiency checks, and you may take a device which is a lot lower on the realistic side and get good training on it, but if you want to get checking credits, it may not be suitable. So that's just something to keep in mind when you're developing your requirements that you might want to give to manufacturers as far as to tell them, give them an idea of just what you're looking for, whether you want your training with it or whether you want your check with it.

CAPT. LAWVER: Is Dominic Marro here from AST? Did you have anything to say? Okay.

DR. LAUBER: Okay. Thank you very much.

The next working group, Working Group IV dealt with the issue of pilot education and safety awareness programs, and I know from their discussions, or part of their discussions that I sat in, at least yesterday, this group was very busy and very productive.

Marty Shearer from Air Midwest and Bill Reynard from NASA was the NASA co-chairman.

PILOT EDUCATION AND SAFETY AWARENESS PROGRAMS

Chairman: Martin Shearer, Air Midwest
Co-chairman: W. D. Reynard, NASA

MR. SHEARER: I'm going to say a little bit and then hand it over to Bill.

In our discussions on safety, there was an assumption made which we found was not true, and the assumption was that commuter airlines have, to some degree or other, a safety program already in force, and we found out this was not so. The programs that we did see were rudimentary, although some companies are trying to expand on it, to improve it, but for the majority of people in our room there really was not a safety program. So the discussion of what was available as far as publications, people that you could bring in to teach you, or how you could improve your programs, as Bill said, was putting the cart before the horse. So we had to backdrop. And what I felt a need for was I wanted to establish a safety program, but how do I do it? Give me some guidelines or show me a publication that tells me how to do it or let me bring in a person who can instruct me how to do it.

So after our initial discussion, we really started focusing on how do I start a training program or safety program. What elements are involved. And after that, then, we started to proceed into the various avenues of information, NASA, FAA, et cetera, et cetera.

So I think I'm going to turn it over to Bill, so he, with all his expertise, can carry off the rest of this.

MR. REYNARD: Hello again. After sitting here listening to this this morning, I'm reminded of a story I heard one time about a very successful business person that was being interviewed on TV, and he said, tell me, sir, what do you attribute your success to? And the man says, two words, right decisions. And he said, well, what do you attribute your decisions to? And he says, one word, experience. And he says, well, where did you get all the experience? Two words, wrong decisions.

Well, as Marty pointed out, we found out that we were about one step ahead of where we should have been when we started, so consequently we started with Step 1, and that was to establish the need for some type of safety program or office. It became apparent, the first thing you have to do in the course of developing this idea and then being able to

present it to the "bean counters" or people who approve such things, is a risk assessment, find out just exactly what risks your company is exposed to as a result of not having a safety program. That shouldn't be too difficult to do. But the thing about it is if you can show that you have done some type of creative homework before you head into the management chambers to say that you need a safety program, and you can enumerate the type of risks most generally and specifically that you seem to have encountered in the course of your assessment, it will have that much more impact.

The second major issue you have to attack is the structure. You want to create a safety program to address the risks that you've just identified, and we'll get into that a little bit further in the next section here, but after you've identified the risks, and identified the type of structure you want to try and achieve, you have to essentially design the function, and that shouldn't seem to be too difficult until you realize that there are really two functions to a safety office. Depending upon how you view it, and more particularly upon how your flight crews view it, it may or may not be successful. You can either look at a safety office as fulfilling an education and training function, or for want of a better term, you can look at it as fulfilling a quality assurance function. And if it's strictly education and training, you'll probably have a lot more cooperation and a better perception on the part of the flight crews, than if it's confused with the very necessary function within a company that involves check flights, operations, et cetera. So you want to create a little space between the education and training and the quality assurance function of a safety office, if in fact, you incorporate the two. It would be better yet if you could have a chief pilot that does the quality assurance type activity and then a safety office. One of the thoughts that was brought up is the fact that when a company is the size that most of yours are, the tendency might be to try and make the chief pilot safety officer. Well, in fact, it's almost a contradiction because of the fact that he's trying to wear two hats. So consequently you might want to take a look at that function dichotomy and find out just exactly how you can fulfill both of those, because both of them do have to be present in any company organization.

And then finally the fourth major issue under the broad concept is motivation. And that comes again in two forms: How do you motivate the flight safety program, and, at the same time, motivate management to continue their support of the safety initiative. Point out to them that it's worth it, it's an ongoing type procedure.

We then went into the second basic issue which would be the elements associated with the implementation of a safety

program, and we don't mean to imply that this is a comprehensive list. This is what one afternoon's worth of talking came up with, and some random thoughts after this filled in some of the gaps.

The first thing you have to do is define the objectives of the program, do an assessment of the program goals and of the proposed program structure. You want to know where you're going to end up before you start. It's like anything else, if you have a goal to achieve, it makes it a lot easier, not only for yourself, but also to sell it to management. Establish the criteria for selection and designation of a safety office or officer, depending upon how you want to do it. Some of the considerations there are qualifications, both aeronautical and managerial. Again it goes back to the issue, perhaps, of whether or not you want the chief pilot to be the safety officer. Those people who have experienced that have found that it has marginal results, and they would like, if they could possibly afford it, to have two different functions there, but lacked aeronautical and managerial qualifications. You can't very well have somebody who's trying to impart safety information who maybe doesn't even know that the pointing end goes forward. You know, if you have some person who is not aeronautically oriented but happens to be the "company safety officer," chances are the program won't have too much of an impact among the flight crews.

You have to look to the credibility, the personality and the peer perception of the person who's designated to head up the safety office. It's terribly important. If you have somebody in there who simply turns off everybody, all you're going to be doing is going through the numbers, and it isn't going to be accomplishing anything, so you have to be selective in a sense that it's got to have the right characteristics to be able to manage the program, but at the same time, have the confidence and trust of the people they are trying to impart the information to.

Take a look at the position within your organization. A safety office, no matter what the organization, whether it's government, military private enterprise, has ranged anywhere from the very important down to, oh, hell, who will we hang to be safety officer. And this is terribly important to create just a little bit of space because the safety office, to some extent, almost has to act as an ombudsman if it's going to fulfill all of its functions.

Take a look at the scope of the safety office. Are we looking at a flight operations safety office, or are we looking at a company safety office? Sometimes when management realizes they're going to have to get in and create a safety office, they also think, well, as long as

we're doing it, let's make this the company safety office and they can worry about forklifts, and they can worry about parking spaces and fire hydrants and everything else. This is not to say that's good or bad, but be sure you know what you're heading into when you make the initial thrust.

Take a look to see whether it's full-time or part-time activity. Obviously the size of the organization, its resources will determine that to a large extent, as well as the person chosen to do the job. And then, finally, what's the composition? Are we going to have an individual who essentially has 100 percent authority to do whatever a safety office should do, or is it going to be a committee that will then direct a greater effort of some type, or is it going to be a combination of both? The thought was also raised that sometimes this could be accomplished through external resources. One of those external resources is at least for one element of the safety program, in terms of being able to provide a form for feedback, to be some type of external group dynamics consultant. Now, we were specifically counseled that you don't call them in-house and you don't call them psychologists because that immediately turns most people off from the standpoint of well, we don't want a psychologist hanging around. The terminology seems to be accepted that what we're talking about is an external group dynamics consultant and it encompasses essentially what you want it to encompass in terms of making that person available for either just reactive counseling or some type of active program.

Possible limitations on the safety function, first is budget. And this is cost not only in terms of expense, dollars in/dollars out, but also in terms of redirected staff effort, how much is management willing to put up with having somebody that's being paid to do one job redirected to do a safety function.

The second element is time and staff availability. Obviously if you're up to your keister in a lot of other things, it's going to be awfully hard to carve out a niche for somebody to do a safety function if they're not already doing it. But, again, it seems to be an important concept and on which most organizations can't afford not to have. You don't want to overlook the use of an existing labor organization if you have one. If your pilots happen to be represented by a labor organization, take advantage of the situation and try and get some cooperation with regard to safety and training efforts.

One of the other limitations might be management philosophy and attitude. Some managements are very enlightened as far as safety in saying go for it, we understand the significance of it; others just kind of bury

their heads in the sand and say what the hell good is it, let's worry about it when the time comes. Well, usually when the time comes, it's too late.

The safety organization's position should be within the total management structure. Again, make sure that the organization has some definition and there is a line going to somebody that has some authority. If you're out in left field, chances are you may exist, but you won't get a whole lot of cooperation or support.

Finally, make sure that the safety office has some kind of access to senior management or representation in senior management circles. If all the head pilots are sitting around a table on Monday morning and every now and then something comes up and there's nobody there to counter the accusation that, well, that safety office is getting in the way, you know, that's safety's function, something like that, you've got to have representation, you've got to have a voice at the senior levels.

There are two considerations with regard to timing and implementation. Most critical is the identification of critical versus nice-to-know issues. If you're going to have a safety office, you want to attack the most critical things first. And finally, an assessment of the availability of resources both external and internal. Obviously, the internal is in regard to money and space, people, facilities, opportunities to get to the crew in terms of being able to fulfill the safety and training functions. External resources we identified, one of the most prevalent ones in terms of your own activities, would be your own manufacturers of the equipment you use. Almost every manufacturer puts out some type of information regarding his equipment, and possibly you can explore that. As somebody else pointed out, if you're going to put down three or four million bucks for an airplane, you have a little bit of leverage. The Flight Safety Foundation, as Jack Enders pointed out yesterday, has quite a few publications and information bulletins that could be useful. The Federal Aviation Administration, specifically the Accident Prevention Specialist -- most people identify APS people as being primarily associated with general aviation, but the fact of the matter is that the example that I cited in the course of this discussion was the fact that I was up at a conference about two months ago and encountered an APS guy that was an absolute genius when it came to mountain flying. Now some of you people do mountain flying, and it's entirely possible that this person who's there to serve and is quite anxious to do so would be willing to come over and do a safety program on whatever the subject is that the expertise exists. So don't overlook the fact that the FAA has an education and training function that they can fulfill

with people like that. The ASRS pointed out yesterday that their publications are available, they're there to be used. The more benefit we get from them, the better off we feel as far as getting maximum utilization from the program. Military publications and films. Most of us, I think, have been through some type of military activity, and we realize that some of the publications and films are best left in the library. But there are others that are really quite good and can be used constructively and usually are available free. Government publications and films, same thing. We have some films, for instance, here at NASA. We have the Western Region Audio-visual Library across the street. Thousands of films are available for purposes of safety and training, if, in fact, they fit the subject area that you're looking at.

The University of Southern California Safety Center puts on a series of seminars, programs that could be useful for your organization, and then, finally, it's a somewhat obscure source, but believe it or not, they do put out some publications dealing with aviation, particularly ground safety, and that's the National Safety Council. They, in fact, have an aviation safety section.

Some miscellaneous thoughts. This is the one that surfaced right toward the end of the program, and I think it's a very valid one, no matter what else we say, you've got to keep in mind, and you've got to stress to the flight crew members that safety really begins and ends with the individual in the operational environment. You can have a real whiz-bang operational environment. You can have the greatest guy in the world being the safety officer, but if the flight crews and the cabin crews and the mechanics and the people who actually do the operational work don't comprehend the significance of it, it's all down the tube.

Keep publications and communications simple, concise and, if possible, confine them to a single issue. Exploit the fact that emerging flight crew members are the product of a video generation. Maximize impact with available training devices and software that can take advantage of their orientation towards this type of training mode. Use mandatory response techniques to critical publications and communications. First identify the criticality of the issues, and then create for all intents and purposes an information file with a mandatory sign-off by each crew member, I have read and understand the foregoing, et cetera. And then, of course, don't overlook the value of the simple casual distribution of the nice-to-know type items.

Don't underestimate the value of peer pressure and constructive tension. An example of this would be the use of recurrent refresher training. Before they start,

identify the issues to be examined ahead of time, what elements are going to be pursued, what bulletins are going to be discussed, what procedures are going to be examined. This allows for two things: Number one, it facilitates prestudy of these particular issues, it creates a more efficient training session, and, in line with the basic item, it creates a constructive peer tension. Essentially what that boils down to is I damn well better study this because I don't want to be conspicuous being the only person that doesn't know the answers. As we've discovered in the course of doing some training research there is such a thing as constructive peer tension, and it can be used to your advantage.

Encourage dialogue among crew members. Use a post-flight critique by the crew members, not necessarily the chief pilot or the safety officer, but when the opportunity permits, encourage the guys to sit down and say, okay, how did that go, what did we do right, what did we do wrong.

Solicit issues and ideas from the flight crews themselves. Don't assume an ivory tower approach to issue identification and methods of information dissemination. Increased involvement creates increased interest. Also, create a clear understanding of why this information is important whenever possible, not only from the standpoint of why it's important that flight crews read the information, but also create an understanding of why the safety office or the safety officer would like to have a response, some feedback. You know, it's the old bit about closing the loop, and that's a very large element in safety.

Increase the emphasis on standardized crew procedures. It's proven to be very effective and can continue to be so with the increased emphasis and understanding on the part of flight crews on why this is important. Be creative in the use of role playing training sessions. You know, if you don't happen to have a simulator or you don't happen to have some of the hardware goodies that are available, several parties pointed out in the committee that what they do is set the crew down and create situations.

There may not be any hardware at all, there may be just a table and chairs, but you create a scenario. What would you do if? And you go through essentially some procedural training without all the hardware.

In line with the previous session's comment, encourage, even pressure manufacturers to develop and offer simulators for commuter aircraft. Some type of simulation capability is becoming an integral element of safety and training within all fields of aviation. There's no reason why the manufacturers who are selling aircraft for big bucks can't

do something to at least assist in that effort.

Recognize that safety management won't be permitted to exceed the level of sophistication of the company's overall management. Lee Bolman pointed this out yesterday, the fact that you may have a really good safety office, a very good safety officer, who has some really good ideas about management, but if he's got a senior management that is short-term, bottom-line period, chances are he won't be allowed to exceed the sophistication of the top management. So you've got to be able to work within your own management and do it constructively.

Pursue the possibility of decreased insurance cost as a result of increased expenditures on flight safety training and education programs. It's entirely possible that you may be able to show a tradeoff, you know, if I can spend sixty bucks for training and we get a sixty buck tradeoff on the insurance cost, then we haven't really spent any money and we're a lot better off in terms of our safety training effort.

To further examine this, and perhaps make your case stronger, you can extrapolate to worse case scenarios: accidents, fatalities, bad public relations and extensive litigation. Point out the fact that insurance doesn't cover all of the cost of a bad incident or an accident. You may get the up-front damages taken care of by insurance, but you've still lost a lot of staff time, you've lost incidental damages. It is really a very expensive proposition. It isn't original, but it's still a very effective approach and that is to say that if you think safety is expensive, try having an accident.

Finally, you ought to point out the fact that the lack of a safety program is a very, very negative element, if in fact you do get yourself into a litigation or a regulatory crunch. If I were a plaintiff's attorney and I was representing the estate of somebody who had a person die in an accident involving an air carrier, and I could prove that that air carrier didn't have a safety program, after I went out and ordered my Porsche, I would go to the courtroom and just make your life miserable, because you can point out not only do they not operate their facilities properly the way they operated the aircraft, but they didn't even care enough to have a safety program. And that's devastating.

Schedule a day for education and training as part of the monthly line bidding. Somebody pointed out that one of the complications was that it was hard to schedule things, it was hard to get people to know when they could expect the education and training thing. So they incorporated the idea that every time they bid a line, that line had one day for

the whole month that was going to be education and training. The management people and the safety office knew that that was when that person was going to show up, that person knew when he or she was supposed to be there, and they just simply worked it out, it was fixed, well identified ahead of time.

Jack Enders made available to this group a reprint of a publication dealing with the design initiation of flight operations safety programs. And he made the offer to the committee, and I'm sure he will make it available to anybody else who might want to get a reprint of that publication dealing with how to start the safety program. And finally, to reemphasize, don't forget the importance of closing the loop. It's always important, no matter what you're doing, to keep both management and the flight crew informed as to what the overall activities and the impact and the effect of the safety program is. It's essentially a PR job. Let them know what you're doing and let them know that you're doing good. That's it. Thank you.

DR. LAUBER: Thank you, Bill and Marty for an outstanding report. Very good report.

Any questions or discussions? Jack Enders.

MR. ENDERS: The offer I made on this reprint is that two papers that were given at our Regional Aviation and Operations Safety Seminar in Rio last June. One is by Captain Homer Maudin on How to Organize for Safety, and the other one is by Hortencio Morsch, Safety Director of Varig Airlines, who described the way his operation evolved from a very, very inauspicious beginning 17 years before to the office he has now. I might point out very briefly that his safety organization is not a big organization. It consists of Hortencio and one secretary and a couple of part-time operational captains that help him out. So no matter how big or small your operation is, you can have a very effective safety function on very limited resources.

Just to make things easy, perhaps I'll get together with Dick Collie and for all those who have registered here for the seminar, we'll just put reprints of this in the mail to everybody so you'll have the benefit of it if that's all right.

DR. LAUBER: Thank you, Jack. Other comments, questions? It was a very thorough report that could almost be a stand-alone publication from this conference.

CAPT. SHEARER: Let me make one comment that I observed in our committee. Of course I'm always harping on costs because my management harps on costs, and two things come to

mind. We don't want to spend much money, but we're a young up-and-coming airline as most of the regionals are, and we haven't got a lot of history. We don't have a built-in safety program. United and US Air, any of the major carriers, they've been around for a long time, and they had to start somewhere just like we do now. And it's easier, they already have the structure experience and they can carry on and expand their programs. And that's -- we're just starting this. And so I find two things. The cost is one factor, and two, you need to dedicate some time and a little bit of research and somebody's got to get the ball rolling in the company and the corporation.

So in our committee and in the presentations here, one, we have satisfied to a degree that there is outside help to give you some hints, some expertise that you can go to. You can call up John or Bill, and we all have business cards, and they've all expressed a willingness to help us all. So you have to, either yourself, or have an individual that's willing to dedicate the time, not a 40-hour week or even a 60-hour week, someone who's willing to put a little extra effort into this. The same thing you used to hear in the Air Force all the time.

As far as cost, you can go a long way with a very little amount of money. I was surprised that when I got here I could call up the ASRS out here and get printouts. That amazed me. I knew we were spending our tax dollars, but not actually on something we could use.

So now we have a lot of sources of low cost information which are readily available to all of us. And I think this is probably the two things that were brought up that were really good in this seminar: Yes, we haven't got much money to spend, but there are things out there that you can get that don't cost a lot. Couple that with the time and a little dedication and a lot of effort, you can go a long way in starting a program. You don't have to go home tomorrow on any of these things we've talked about and say I've got to have a whole full-blown program. It's got to start somewhere. And if you start off on the right foot and continue to put effort into it, it will grow and expand and will get better. This idea that you have to have something now I think it's just an idea that we shouldn't foster. We've got to begin somewhere, and in most cases, starting with something is better than nothing that we have now.

DR. LAUBER: Let's move on to Working Group V. You know, one of the thoughts that we had when putting together this conference was the recognition that simulation is in very short supply within your industry, and that has some implications for the use of aircraft for training. Clearly, almost all, if not all, of your training is currently done

in the aircraft. It seemed to me that it might be interesting and fruitful to see what could happen if we put a group to work on the issue of developing some innovative uses of aircraft for flight crew training, questions like can some of the concepts used in line-oriented flight training be built into the aircraft training curriculum, and similar considerations? That was the principal impetus for including Working Group V.

Mike Sele from Air Wisconsin is the industry chairman, Mike Baetge from NASA is his co-chairman, and why don't you gentlemen come on down and present your report.

INNOVATIVE USES OF AIRCRAFT FOR FLIGHT TRAINING

Chairman: Mike Sele, Air Wisconsin

Co-chairman: Mike Baetge, NASA

MR. BAETGE: Thank you, John. Good morning. The theme of our presentation is the development of ideas and ways in which to increase effectiveness of the aircraft as a training device with particular attention to the application of LOFT concepts to the aircraft in its home environment. Rather an intriguing subject, we found.

We were fortunate in our group to have representation from the aircraft manufacturers and a simulator manufacturer as well as operators and companies who operate with single-pilot operations and operators using four-engine jet aircraft. Our exchange of ideas was enlightening and the input was quite diverse.

We began with a given. The given was that there was some required and necessary training, aircraft and the LOFT concept. Our objective was to find a solution or, if you will, devise a plan in which to integrate our three given variables into a workable, practical solution.

At this time I'd like to introduce our co-chairman, Mike Sele, who will present some of the ideas that precipitated from our discussion. Then we'll open it up for some questions at the end.

CAPT. SELE: Thank you, Mike and thank you, John.

I think the first order of business that we ought to cover this morning that has been brought to my attention by a local TV channel and a number of my committee that today happens to be the 25th anniversary of NASA, I understand, so congratulations to NASA for inviting all of us here to use their facilities and for all the expertise and help that we have gotten from your people, the kind hospitality, and thank you very much.

Yes, we do have a diverse group in this working group, and we have an number of people from the single-pilot operation. We had the manufacturers from the Boeing Airplane Company and from British Aerospace. We has some people from the CAE. Our group was of a size that we decided to stay in one group rather than to split up into two or three different smaller groups.

One of the first comments out of the bag over there, I think, was that indeed what we're looking at doing is going to set aviation back 20 years. By that I mean that 20 years ago or more the people at United, TWA, American, all of the major carriers were going into the simulation business and getting out of the airplane for training. And here we are in 1983 with a working group trying to make a decision about going back, indeed, not using simulators, but using aircraft in flight training and LOFT training. We've all been doing it in flight training for some time, so that's nothing new to us. We use it for initial, we use it for recurrent, we use it for upgrade, all of the rest of them.

One of the first objectives for our committee that we have to identify is the reason for using the LOFT training in this circumstance to minimize the total aircraft flight time for training. Obviously if we can minimize the training, there is going to be an economic benefit to all of our companies.

We were to look into the use of aircraft rather than a simulator, and we were also trying to look into the use of the LOFT principles with an aircraft environment situation.

Those objectives gave us a lot of areas to work in. One of the things that we first looked at, however, was does a need exist for this particular type of training? Yes, definitely there is. One of the problems -- or an area that we saw there was that financial expenditures are considerable for training, and we're just adding more and more to it as we go along, and perhaps with the proper use of the LOFT training, we can reduce some of those.

We feel as a committee that the aircraft can be used either as a static or a dynamic training device with some problems associated with both. The Triad concept this morning I had not heard of either. That's an interesting idea.

A number of the carriers involved yesterday made some comments that during their initial operating experience they required a trainee to ride in the jumpseat. One of the comments was made that perhaps when this individual goes to City X, Y, or Z, he'll even know where operations is, he'll know where the gate is, he'll know the layout of the airport. Some of those things are required under a 121 operation. As many of you know, however, under a 135 operation, it's not always a requirement, and it can save some time.

One of the things that we do at Air Wisconsin in our training program that does employ some of the principles of the LOFT training, we normally try to use two pilots at the

same level. If we have two captains, for example, that are upgrading into the 146, we put one in the left seat, we put one in the jumpseat, and we put an instructor in the right seat. The gentleman riding in the jumpseat thereby gets to observe all the mistakes that his buddy makes and sit back there and say "hey, dummy, you forgot this and you forgot that" in his own observations. And then you reverse the role and put him up there, and other guy sits back there and says, "hey, you dummy, you forgot this, you forgot that." They both learn a lot from that. So I think that can be of great benefit.

One of the problems or concerns that we found from our committee, is the availability of the aircraft. Here again, we are competing with the revenue schedule and with maintenance for the aircraft. Another concern or problem that we see, and probably should have been identified as the number one issue is safety. Safety, again, in this type of training, you're getting more exposure, you're doing a lot of different things. Any time you get that airplane in the training environment, the potential for an accident or an incident is certainly there. You're also looking at the human and the aircraft limitations during this type of training. You have to be aware of those particular problems.

In line with the availability of the airplane, we find that we're all doing our training at night after the airplane ends revenue service and prior to entering revenue service in the morning. So we're doing our training between the hours of 10:00 p.m. and 4:00, 5:00, 6:00 a.m. in the morning, with the exception of our committee member who was in the air freight business -- they fly all night long, and then they use the airplane during the day for training.

Another area we were concerned about was that in order to utilize an aircraft as a dynamic training device, it requires a great deal of advanced planning and a thorough workout of a scenario. It takes a great deal of time to set this up to get it into something that will work, where the LOFT concepts fit into the flight training.

Another problem that we saw and that concerns us -- it happens every time you go up to do a check ride, it happens every time you go up to do any kind of flight training, and that it's very difficult to control the environment in which you're working. The ATC environment, the weather environment, all of these things make it difficult at times.

Some of the advantages, the pluses that I had mentioned earlier in my opening remarks on the first day, one, we're all aircraft operators, so obviously we all have airplanes, so you don't have to go out and buy another airplane

necessarily to do this training. So the capital outlay there is not very great. It is, however, for the cost of the aircraft operation during the training.

Another item that we find by use of the aircraft is that we definitely have a realistic situation. What can be more realistic for training for flying than to be up there flying the airplane. You're going to encounter all of the things there. The pilot is going to have to continue to fly in the airplane and cope with and respond to the other elements that are introduced.

One of the things that was pointed out by one of the simulator manufacturers was that flight crews seem to accept flight training in an aircraft more readily than they do simulator training. The comment was made earlier that if he misses the same approach three or four times in a simulator, he turns around and says the damn simulator doesn't know how to fly. If you do it in the airplane, it's pretty hard to blame the aircraft in that particular instance. There's a psychological advantage, I think, to have the actual airplane in that particular instance.

There is another area that we found that was quite beneficial to a couple of our operators. They were in a situation where if they have an essential air service route or if they are into a circumstance where they may have an aircraft that is flying a segment with no revenue on board, they can combine that particular segment with flight training, with LOFT training, and a number of them do that. The air freight operation -- there are times where they're deadheading an airplane back without any freight on board or revenue on board, so they're able to conduct a limited amount of training during that segment of flight, and thereby reduce their overall training costs. As all operators do, we end up deadheading aircraft from Point A to Point B for some reason whether it be maintenance-related or positioning of an aircraft. Again, some of the operators took advantage of that particular situation, used deadheading flights or ferry flights for training purposes.

The alternatives to using aircraft have been explored quite extensively earlier. We, as a committee, felt that if the Regional Airline Association had some of these video tape presentations available, it would certainly benefit all of us, and we highly endorse the RAA establishing a library of these things. If we could get more of that, that would be a real plus for us.

A situation was explored earlier talking about a mobile simulator or a generic mobile simulator, if you will; again the manufacturer was in our committee. They do at this time make mobile simulators for the military operation and

application. Perhaps that's another area if they were available in Philadelphia, and Frank was mentioning that there are a number of operators within a hundred miles of the Philadelphia airport. Certainly a hundred mile radius would not be difficult to cover with a mobile van of some sort, thereby giving you access at your base to that simulator on a specific time frame.

Again, another alternative that we found was the use of CPT's or IFT's, the use of the static aircraft for those particular things. We feel that those can significantly reduce the training costs and the use of the aircraft.

The recommendation that we would make as a committee is that all training should be standardized and specific guidelines developed to increase the effectiveness of the LOFT concept utilizing an aircraft. If you're in the short-haul business, you may want to explore the possibility of making a long-haul training scenario. An example was given in our meeting of an operator coming from Jamestown, North Dakota to Minneapolis, Minnesota in a Merlin Metro. It's about an hour and 15 minutes. Their alternate for that particular day with the weather circumstances that we have in the upper Midwest was back up in Montana. It's an hour and 15 minutes down to Minneapolis, it's an hour and 15 minutes backup to Jamestown, and it is two hours and some odd minutes over to their alternate. They just went into the long-haul business if they miss that approach to Minneapolis. So it's not saying that your scenario would run the entire gamut of that, but to prepare for that. It certainly lends some credence to flight planning, training in the use of forecasts and all of the other information there. Most of us get in the airplane and we're going to be at our destination in 28 minutes or 30 minutes, ten minutes in some cases. We just opened up a new segment with the 146. To give you an example of that, that is from Appleton, Wisconsin to Green Bay. It's 15 nautical miles. We're going to do that in a four-engine turbo jet. The gear is going to stay down, and the flaps are probably going to stay down, because when you take off and level off, you're on the approach to Green Bay. It's going to be a very quick trip.

We had an outstanding session over there. The committee members really participated, and we really appreciate all the help from everyone. I'd like to thank all of them personally for their input, and at this time we'd like to entertain any ideas or questions, comments that anyone has, and so we'll throw the floor open for those. Thank you.

DR. LAUBER: Thank you, Mike. I apologize for giving you this hot potato, because it is, as Mike said, one of the least well-defined and I think you've done a remarkably good job with it.

Are there comments and/or questions for Working Group V? Harry Orlady has one.

CAPT. ORLADY: Harry Orlady from Battelle. I think there's another way to use the airplane for LOFT training and even for resource management training that's probably the most cost effective of all because it doesn't cost anything. That is to aggressively support incident reporting, because if you think of it, the very act of reporting an incident requires -- well, first of all, the incident is something that people wouldn't want to happen. It's an unwanted occurrence. And the very act of reporting and analyzing it provides greater insight and awareness of that particular problem. It's highly specialized, it's individualized, it deals with exactly the problem that that particular crew had at the time. It certainly doesn't cover the whole spectrum of LOFT or resource management training. It has another interesting aspect, and one of the more subtle ones was the one that I think Hugh Drummond dealt with, and I've forgotten whether he used the term self-actualization or self-realization, but pilots feel better after reporting about the whole incident, and if they use the ASRS system, which I would highly recommend, of course, it has another advantage, a particular advantage if they get a call back with it, because they get a sympathetic rehash of their incident and some of the issues involved and invariably end up feeling better. It's not surprising at all and not unusual to have the men say as a result of this incident, I'm changing my procedure or I'm reevaluating things, and it doesn't cost you anything. But passive support of the program I don't think is approaching anywhere near its potential.

CAPT. SELE: The point is well taken. I think that I made the comment earlier, that we at our company require the pilots involved in any incident to write that incident to us. I have a whole mountain of these irregularity reports, as we call them, but if it's anything involving any area that I feel would be beneficial to anyone else, to the crew, to Air Wisconsin, to the rest of the aviation community, I highly encourage the individuals to submit those to ASRS. I think it is an excellent example, and I agree with your analogy there, if they write it down, they've had a chance to ventilate their feelings on the issue, and once in awhile that helps clear the air a great deal, and it is an excellent tool.

A VOICE: It came out very early in our talk yesterday all of us engage in LOFT, we just didn't know what it was. Most of the people in the room here have been through proving tests of one form or another, and at Simmons Airlines, we just went through a 121 with a Shorts 360. I know Suburban has gone through it recently and Air

Wisconsin. And if you look at the LOFT in the context of proving runs, on the airplane, what you're actually getting is a line-oriented flight test during the proving test, and all of the pilots in our company that participated in the proving runs received valuable LOFT training. However, as soon as that is over, our training reverts back to just passing that FAA check ride. And so that cause lost. Many of our pilots come along after the proving tests. So I think that is really what LOFT is all about, carrying the proving runs down the line to everybody else within the company, hopefully going through all the possible scenarios that go along. We all do it in the initial operating experience to a certain extent, however, with passengers on board the aircraft, you're very limited in what you can do with a crew. So we did discuss yesterday having to use the airplane for dedicated flights to operate real LOFT scenarios.

DR. LAUBER: Excellent comment. Okay. Thank you, again.

The last working group we'll hear from this morning, Working Group VI, also had a difficult topic area to deal with, in that we were opening up the whole question of innovative approaches to recurrent training programs. Hank Noon of Command Airways was the industry chairman of this, Miles Murphy was the NASA co-chairman.

INNOVATIVE APPROACHES TO RECURRENT TRAINING

Chairman: Hank Noon, Command Airways

Co-chairman: Miles Murphy, NASA

CAPT. NOON: We elected to use the panel approach. If Guy Crow is here, we'd like to have him join us. Francis Cash from PBA had agreed to sit on the panel, but unfortunately he was called home this morning.

We had a very large working group. There were 15 of us in the room discussing these problems of recurrent training, and we had quite a wide range of people from small operators on up to the very large operators, and so it was a very diverse group and a lot of discussion before we really were able to settle down to put some ideas on paper. It was a surprisingly active group, very bright and a lot of enthusiasm and a lot of ideas. Since we ran so late, most of the participants had to run for the bus, and Miles Murphy and I finished up making a very brief outline. We will go through our outline and try to fill it out as we go along.

The first thing we did was to question whether recurrent training is necessary. It was unanimously reaffirmed that there is a need for recurrent training, and that it is a very important element in every training program.

We tried to set down some objectives of recurrent training. The first one is to fulfill legal requirements. The second is to fit the needs of the airlines, and in this regard, we felt that it may require some type of petition to change FAR's so that innovation is encouraged, and I think that RAA has already started to work on that. So we didn't go any further.

Number three is that incorporation of cockpit resource management is an absolute necessity.

Number Four is program guidelines. Needs and objectives derived from analysis, including cockpit resource management must be developed and incorporated. Mr. Murphy, do you want to comment on any of these as we go along?

MR. MURPHY: I'll indicate something that was pointed out, that guidelines must be tailored to the company's pilots and operations -- (that they must be more than general guidelines.

CAPT. NOON: I think initially in view of the fact that

we are getting into something new for many of the airlines and some of them have obviously started a program to incorporate cockpit resource management and LOFT principles. But since this is new to most of the airlines here it is time to systematically analyze the tasks that must be performed, tailor the training program to meet the needs, establish standards that have to be met, and determine the skills and knowledge needed, and their availability.

The next thing discussed was how to meet objectives, considering both and cost effectiveness since we are all cost conscious.

Another suggestion was that we need a continuous feedback system; both to maintain the program and the standard, or to change them as needed.

One thing that continually kept coming up was that the group hoped that RAA would supply the leadership to develop an overall program that each airline could tailor to its needs. Another idea was that a training group be established within RAA. Another suggestion was to make use of accident/ incident analysis, possibly consulting with NASA to provide the data and figures as to where we should put our emphasis when we do recurrent training.

MR. MURPHY: Just to add to that, I think Bill Reynard mentioned risk assessment, and that seemed to be the concern of many of our group: not knowing exactly what some of the risks were with respect to specific tasks, and hence, training priorities. It was felt that analysis over the industry was needed, and that we now have more for the large carriers than for the small carriers, or commuters.

CAPT. NOON: We could see where we pretty well narrowed it down to the highest risk areas in the takeoff and initial climb-out regime, and also the approach and landing but that isn't specific enough. What we would like is some data as to the history of these accidents, exactly what it is in the human factors that causes the most accidents, and zero in on them and try to find a way to train the crews to avoid them. At least make the crews aware of the dangers in these particular elements.

MR. MURPHY: One other suggestion in this area was that it might be good to have a seminar for training trainers that was sponsored by the RAA.

CAPT. NOON: Some of the reasons that were given by the group was that they felt it would be less expensive overall if the RAA could put together some kind of a program rather than the individual airlines trying to go out and hire consultants or obtain the necessary expertise, that some of

them just don't have the resources to do it, and possibly in some way it could be consolidated by the RAA.

MR. MURPHY: Also, there were several suggestions in our group for generating video training tapes. That point has been made by some of the other groups, as has the idea of a list of appropriate training devices. It was suggested that RAA and NASA participate or perhaps take a central role here.

CAPT. NOON: Some of the program elements are: ground school, with such things as video tapes, which should be interesting, stimulating and motivating. If you don't hold their interest, they are not really going to participate and benefit from it.

Two, training devices, credit should be given for use of part task simulators or training devices and the optimum use of the devices. Again, I think a lot has been said about simulators and the problem of their cost. Use of a simulator or training device is the ideal. Using an aircraft for training works, obviously, but one drawback to training in the aircraft is that the instructor must occupy one pilot seat, whereas in a simulator you can have the instructor standing back while the captain and first officer work together as a team. We think that's an important element.

Number three, simulation. I think that's been covered pretty well already.

One unique idea came out in regard to usage. That was the possibility of getting credit for observing a pilot, who's soon due for recurrent training, doing one of the items that is on the proficiency check while he is on the line. The idea is for it to be legally possible to sign that item off on his proficiency check and not repeat that item. I don't know whether the FAA would buy that concept, but for most of us the operation is such that our check airmen are out doing line checks or even flying as pilot in command. There is also the possibility of doing some of this checking on the line and signing it off. It would be done under actual conditions probably with a heavy airplane versus a light training airplane, and I think it has some merit and we should explore it, anyway.

To summarize, we have to systematically analyze what we need in the way of recurrent training, and start off with a fresh program that will incorporate the cockpit resource management and the LOFT principles.

MR. MURPHY: One additional concern with respect to cockpit resource management was the one-man versus two-man

crews. I know Clay mentioned that interpersonal interaction within the cockpit was a major focus of CRM as they addressed it. But there was a lot of concern expressed about resource management for one man crews, and a recognition that although requirements would differ, there was a large potential for resource management application there.

Another thing with respect to resource management was that it should be introduced in initial ground school and kept as a major part of the ground school throughout recurrent training.

Another concern was with pilot in command versus second in command. Some airlines have crew members who have only flown as pilot in command in a single pilot operation prior to coming to a two-man operation. Initial training was the major issue here: doing something about resource management training, but there were possibly some recurrent training issues also. It was pointed out a simplified, LOFT-like scenario could be done using two chairs and a cardboard mockup, that you didn't have to have a full-time simulator or training device to handle that problem. One group member later identified one of his concerns that was not discussed in the speaking session: recurrent training should motivate continuous learning throughout the year, and not be looked at as occurring only during the training day.

CAPT. CROW: This is sort of an additional summary. In our discussion we all acknowledged again that in all phases of life, modern day personal life and occupational, ongoing training, refreshers, returns, whatever, is absolutely necessary to survive in the changing atmosphere and environment. So once we acknowledge that, we must attempt to simulate and to use all the devices possible to make the training as meaningful and as objective as possible. Too often training by operators is approached with the idea of meeting a legal obligation, let's don't go through that again. We must accept the fact that training is essential and will pay dividends, obviously, in safety records and so forth. All the other panels have discussed various ways that we can hype up, if you will, the training to make it more interesting and meaningful to the participants.

CAPT. NOON: There are just a couple of other miscellaneous items. It was pointed out to us that the people who really have studied these training programs say that a device doesn't necessarily have to exactly duplicate the airplane to have value. In other words, in the past, the governing concept was that training had to be done in an airplane to have value, or some device that felt exactly like the airplane. It was also pointed out that experience now indicates that this isn't necessarily true, that you can

have a reasonable training device and do a maneuver that doesn't exactly feel like the airplane, yet the experience can train you to handle a similar situation in the airplane. In fact, when a person so trained does subsequently perform in the airplane, he or she does just as well as if the device exactly duplicated the airplane. I think this idea opens up some new thinking on the use of devices that are not necessarily full simulators.

One other thought is that any way of mechanizing has an advantage of reducing cost, but also better standardization and more consistency in the training because instructor variance is eliminated. One instructor may cover one point more than another, or she or he may even omit a point with one student and pick it up and spend more time on it with another student. So, there could be more consistency in a mechanized program than in a program that uses an instructor. Of course such an approach should contain the proviso that someone be readily available to answer questions not adequately covered by the mechanical program.

MR. MURPHY: Two other concerns were expressed; and they may really be one: First, how to evaluate alternative training methods in terms of effectiveness. How do you measure? That is an old problem that was really brought out several times in our group. The second was how to ensure that needed behavior changes are being produced by the training program. I think these two concerns may collapse to: how do you measure or evaluate the effects of specific training content and methodology both in the short and long run?

CAPT. NOON: It would seem as though if you went into that kind of a program you would have to run a certain number of students in the simulation, whatever it happens to be, and then test them in the airplane to see if it really, truly was effective.

MR. MURPHY: Yes, and I might have concluded my statement by saying that measurement and evaluation methodology is an appropriate research area for NASA. During some later thinking I developed a mnemonic that summarizes and gives a general sequence for the major training program developmental steps that we discussed. In that it may be useful to others, I offer it here: A "NEED" approach to training where N = Needs assessment, E = Elements of Instructional Content, E = Evaluation Procedures, and D = Devices.

CAPT. NOON: These seem to be the more important points and the highlights of our group's efforts, and that's all we have unless someone has questions.

DR. LAUBER: Thank you, gentlemen. Any questions or comments that you want to direct toward Working Group VI?

I think one of the issues that you brought up that resource management applies to the single-pilot operation is an important consideration. I think there is more to resource management than simply the interpersonal aspects of it.

Any comments or questions? Yes, we have one here.

MR. SCHOBBER: I think one of the items that's been alluded to throughout the program but really never made explicit was the fact that by and large most flight and ground instructors' background really isn't in education, and yet a lot of the items we're bringing up have to do with such factors as instructional design. We don't really have the background for that. We really need some help in that area, I think.

CAPT. NOON: Well, I would say that this would be part of the systematic evaluation or analysis of what our needs are, and then finding the means to achieve the training objectives.

MR. SCHOBBER: Yes, it's that evaluation process that we really need some guidance on, and I think that's an area probably where NASA can help us out.

DR. LAUBER: Yes. NASA can possibly be of some help in that, although, I would encourage you to resort to resources that already exist in that area, and perhaps through the RAA again, pool resources. There are organizations that are in the business of providing training and analysis and consultation with regard to the structure of training programs. I think your point is very well taken, that expertise does not generally exist within individual carriers except for the larger ones, and that it is necessary to draw on that kind of expertise and pull together to design an appropriate training program.

MR. BENSON: Ed Carroll had made a comment before about setting up standards -- the type of pilot characteristics that you're looking for, and then in a screening procedure starting to target those and eventually increasing the maturity of our pilots. One of the things you might want to consider in recurrent training and evaluation, each one of them separate, but also linked. So that as you set a person model in place of the type of pilot that you're looking for, with the personality characteristics that ultimately fit that person model, then you begin to bring into your pilot grouping the type of individuals that fit the image that you're looking for down the road. Link your recurrent

training to the management characteristics that you really want in the cockpit. Begin to establish performance standards that are measurable, that really give you some idea as to the efficiency of the pilot and his crew, and then begin to hold supervisors, chief pilots, et cetera, accountable for the maturation of the performing standards of each of their pilots. As you identify the strengths and the developmental needs in training, you then hold the supervisors accountable for maturing those particular performance standards in the pilots while they're in the cockpit. Even though screening, training and evaluation are three different areas, they do have some overlap and do need to be addressed in the linkage type of concept.

CAPT. NOON: I agree with you on this, and I can speak for Command Airways and what we base our evaluation on. For a new hire, we have a probationary period, and we evaluate him on his potential as captain, not as a first officer. We start that process right from the beginning and, in fact, I have a meeting with the president of the airline the first Monday of every month, and we review the people that are still in the probationary period and comment on their progress. We have a pilot review board who also looks at the evaluation forms that we get. We have a regular program. The evaluation forms go out to the captains twice a month and they fill them out to determine if he is ready to be a captain, and whether he has the potential of being a captain. That's the way we review them, and I think it's a very important point, and we probably didn't address it because we were focusing on the recurrent training, but this evaluation process could well be part of the recurrent training program.

MR. CROW: As an example, I'd like to point out a thought that has occurred to me of what this conference, this seminar is all about. We must expand our horizons in the area of training. An example I want to cite is that after many incidents or accidents, or irregularities, et cetera, I have seen the pilots involved called in for a proficiency check. "Something is wrong with these people, let's take a look at them." I believe I've yet to see one fail on this proficiency check done immediately afterwards. So maybe the things we've been training in the traditional maneuvers and the handling of the system, and the methods we've been using aren't doing the job, because after they've been involved in these things, they can, in most cases, demonstrate proficiency. So I thought I'd like to bring that out as the very epitome of what we're talking about, that they must reach out and decide what is needed in training.

DR. LAUBER: Mike Yocum had his hand up.

CAPT. YOCUM: Mike Yocum, Pennsylvania Airlines. I'd

just like to comment on the single-pilot issue as it pertains to resource management, and perhaps in our presentation we didn't touch strongly enough on the importance of resource management for single pilot operations. I think I can identify a little bit with this and perhaps you can also, that each one of us become involved in personal management to where perhaps we have meetings with ourselves to determine our direction, whether or not we're reaching our goals, and to reassess our individual management techniques, perhaps, and just how we function alone in our own office. In the cockpit environment there's many other resources available when we don't have that second or third crew member. We have the resources of Air Traffic Control and, as Clay did point out in our presentation, we have the hardware resources within the aircraft, itself, and the software in the case of enroute charts, approach charts and so forth. All of these resources, again, have to be properly managed, and while we've tended to focus on the human element involved in this resource management, very definitely it all has to come together to where even the single pilot operator and the single pilot, himself, needs to be exposed to the concepts of some sound management practices. Just to give one more example, I can remember in the very early days of learning to fly, one of my instructors pointed out, that if I were sitting there fat, dumb, and happy as he put it, I was probably missing something and avoiding proper resource management, although, he didn't use those exact definitive words of resource management. Thank you.

DR. LAUBER: Thank you Mike.

Other comments or questions? Yes.

CAPT. DEREN: James Deren with Air Kentucky. The question was brought up awhile ago about maybe having someone that's on your staff, let's say, a training director, that they usually come up through the ranks of pilot and they're not experienced in education or any other needs you may have in your company. I'm sure every one of us here has a stack of resumes this tall, and one thing you may want to do is take some consideration when you hire somebody that you don't just completely go by the flying skill and their background in aviation. I currently have on file resumes from two lawyers and also a CPA, and not necessarily would that person fit in your flight department, but that is one source of getting some expertise in a small company if you want to pursue that direction.

DR. Lauber: Thank you. Yes, that's an interesting comment. This issue of selection has come up several times directly and indirectly throughout this conference, and I

just might add a comment that it is an extremely important element of your overall flight operation program, and I think there are some significant issues with regard to pilot selection standards that we probably don't even have a good handle on yet.

Let me give you one example. I think it's easily conceivable that the introduction of new technology in aircraft cockpits and the implications that that has for the airman's role in operating the system and flying the airplane has implications for selection standards. I don't find it impossible, in fact, I think it's extremely probable that the personality and other characteristics that we selected on twenty years ago or five years ago, or even now, for conventional technology airplanes may not apply in the future. I think there's been a shift in the system, and there's been a shift in the demands placed upon the people who operate the system. That has some implications for selection standards. Clay Foushee and I have been trying to map out some research in this area where we look at the whole question of selection standards and how that applies to new technology. So it is an important issue.

Are there any other comments or questions?

I'd like to thank the members of Working Group VI for their report. I want to make one final comment, and then I'd like to turn the podium over to Walt Luffsey and Alan Stephen before we close. This has been a very wide-ranging discussion, and I had some concerns when we put the program together, that, in fact, we might be ending up sort of diluting the focus of this whole conference by trying to attack the broad spectrum of issues that are related to training. I decided the risk was worth it, because, as the gentlemen pointed out just a few minutes ago, I think one of the things that has come through in this conference is that training is a system. It's a set of interrelated elements that are operating synergistically to produce a desired outcome, and trained airmen. You can't tack on this, or take away that, without affecting the way the entire system operates. I really encourage you to think about your total training requirements in a systems context, and to take advantage of expertise that is available to help in the analysis of your training hardware and training software, and so on and so forth. I think that was one important theme that I think did come through in this conference, and I hope that you all find that useful in meeting your own training requirements.

I'd like to thank all of our speakers whom I thought did an outstanding job. I'd like to thank the working group chairmen, both NASA and the industry people, and of course, all of you, because through the working group discussions,

as I said at the very beginning of the conference, it's your efforts that have produced the useful product, the useful output from this conference. I hope that the proceedings will be useful as a reference book, a set of guidelines to stimulate the way you think about your approaches to flight crew training, as a reference to find out who's doing what and when and where and so on and so forth. So I think from everything that I've heard and see, from our point of view, the workshop has been successful.

As I said earlier, we were fortunate to have Walt Luffsey, the Associate Administrator for Aviation Standards, with us today, and I'd like to ask Walt to come down and say a few words to us.

MR. LUFFSEY: Thanks, John. I'm really delighted to be here, and I want to thank you and Alan for the personal invitation I received, and I'd like the opportunity of being able to say a few words, too.

As I listened through what was said today, I took a few notes, and I'd like to start out by saying that I really am truly extremely impressed with the content of what was discussed. Note the word content started with C, so I started using the letter C to pick up some of the key points that I heard, and in a couple of places I'd like to emphasize some of the thoughts.

You mentioned coordinate. You mentioned cooperate. To me, those are two very important words. We need to carefully coordinate and we need to cooperate. Government and industry, FAA and industry, NASA and industry, and you took a single step today in that coordination process.

You mentioned cockpit resource management. You mentioned credits. When you talk about credits in checking, I'm going to bring you to a thought on that. I sometimes wonder if training programs truly have the right objectives or if our individual thinking really has the right objective. Not the FAA credit, that's not what's important, it's that the training program will meet safety objectives which you set.

You mentioned change, you mentioned creativity. Note all of those starting with C. You mentioned coherent and cohesive. All of those are necessary ingredients, obviously. You have spoken to credibility. And I want to emphasize that. Credibility of your program. You mentioned court. I'll give Bill Reynard that one, and I'll use it as a trigger to get me to where I want to talk.

The statute. I'll take it out of the judicial back to the legislative. The statute sets in motion your own reason

for being, not ours, although it articulates the need for FAA or CAA previously. We exist because of you, because you want us to exist, even though, individually you might not always feel that.

It's interesting to note what the statute requires. If you take two legs of the whole process, it requires that aircraft be manufactured to minimum standards. It requires that aircraft be operated at the highest safety level possible. Now that's paraphrasing, obviously. The FAA in the operating part of the business simply set minimum standards. You must at least meet those, but you're expected to operate to the highest level regardless of what those standards say. I wanted to point that out particularly. The role of FAA is simply standard setting. We do some checking on the system. The check ride itself is part of the system and not the means and the end to that system.

I guess the biggest C of all is that you today communicated. I heard, I listened, Dan Beaudette, who's been here all week did. Without pushing the objectives concept too far, I do want to mention one more time, FAA is receptive to change, another C, to innovation. You come to us and you tell us what you're trying to achieve, how you're going to get there, and if you make reasonable sense with it, at least we'll listen. We have the same interest you do: high safety standards, operation to the highest level of safety. I think you'll get that support from us. We are receptive to innovation.

I'm going to close out, although I could mention other C's like concern and cope and continuous feedback and all those notes that I took. I'm going to end up by re-emphasizing another C I heard, and that was congratulations on your birthday at NASA. We recently had ours, and it is a signal event. Twenty-five years in this part of the business at FAA, NASA, I had some experience in CAA before, and it's fantastic.

I want to thank all of you for being here and indicate to you that we'll try to do our part. Thanks, again.

CONCLUDING REMARKS

DR. LAUBER: Thank you, Walt. It is interesting the 25th birthday is today. From my point of view, I'll just add my own two cents to that. It's been an incredibly rewarding thing to work for this agency. We've had a lot of opportunity to work some interesting programs, and I hope to do some good, and I have thoroughly enjoyed every minute of it.

Dick Collie, did you have anything that you wanted to say before I turn it over to your boss?

MR. COLLIE: No, I can't improve on anything.

DR. LAUBER: Okay. Well, I want to thank you, Dick, for all the help. It's been a pleasure working with you in organizing this conference, and with that, I would like to turn it over to Alan Stephen, the Vice President of Operations for the RAA for some closing remarks.

MR. STEPHEN: Thank you, John. I would like to set the record straight. Dick Collie doesn't work for me. I live in mortal fear that Dick Collie will some day decide that he doesn't want to continue with us. It should be pretty obvious from the kind of role he's had at the RAA, that we look to Dick to provide real leadership.

Listening to the recommendations I heard this morning, I didn't hear one word about a need for regulation. What I did hear is that we have to do a better job in training whether as individual airlines or as a collective group of airlines under the banner of the RAA. That's a very important point, and it is the kind of leadership for which we look to Dick Collie.

The reason I was late to this workshop -- I wanted to be here all three days -- was that the General Accounting Office, an independent arm of the Congress, did a real hatchet job on our industry this past week. They are about to issue a report that said our operations are 20 times less safe than the operations of the large air carrier airplanes. To arrive at that conclusion they had to include the operations of air taxis, cargo, Alaskan bush operations even helicopters in the accident record. When, in fact, you sit down and look at just scheduled commuter operations to large air carrier operations, the safety records are very comparable. For example, on the accidents per hundred thousand landings, the average for the jet airlines is .38 accidents per hundred thousand landings, while accidents across our entire industry is about .63. So they're in a

general comparative range. Not twenty to one as the GAO concluded.

But in raising the issue, I did go back to look at each of the 47 accidents in our industry over the past three years. I was impressed with a couple of facts about those accidents. First, is a spectacular lack of causes that we saw in the past. Only one of those accidents related to weight and balance. Not one of them resulted from a crew member overscheduled or fatigued. There were no accidents stemming from a lack of maintenance or operational reliability. And, in fact, those accidents causal factors broke down to approximately 50 percent related to the pilot, 30 percent related to maintenance and other types of ground operations, and about 20 percent related to the environment, the ATC system, weather, that type of thing, a percentage distribution very comparable to the accident statistics of jet air carrier operations.

While many of the accidents were minor there's still some accidents that shouldn't have occurred, for example, an airplane taking off with a gust lock installed. I think that was the first thing I learned during my first flying lesson 20 years ago. Six accidents involved aircraft while they were taxiing on the ground, usually from carelessness. Two accidents related to refueling, refueling a piston airplane with jet fuel. I could go on with such examples. The point I am trying to make is related to quality, and that's what cockpit resource management is all about. Quality and not more regulations in trying to eliminate those causes of accidents.

I liked the recommendations offered today very much. Because the RAA doesn't have to produce a hard dollars and cents bottom line, we can go back to our board of directors and, indeed, the entire membership, to get the resources for CRM. With your cooperation, we can do many of the things I heard this morning, and in cooperation with Dick Collie and your input, I'm sure we'll be back to you in the very near future with some ideas of what we can do in 1984 in those areas.

I hardly need to say that this workshop would not have been possible without the resources, the personnel and the dedication of the people of NASA, particularly John Lauber. I can only express with a great deal of gratitude, the appreciation for everything you've done in opening up the dialogue and giving us, perhaps, a sense of direction as to where we ought to go in the future in training. I'd like again to congratulate everyone here in the NASA organization who's been a participant on this program.

DR. LAUBER: Thank you, Alan. With that, once again,

my thanks to everyone who worked so hard to make this program go. It's been a pleasure, and we look forward to the next time we can all get together. Thank you.

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16. Abstract Regional/commuter air operations represent a significant and rapidly expanding segment of the aviation industry. The great diversity of aircraft, routes, and aircrew characteristics requires innovative approaches to the training of aircrews. This report reflects the wide range of issues now facing regional/commuter airline operations. Papers from NASA, industry, and academic representatives are included covering training technology, theory, method, and operational experience. Reports from six working groups are presented which address cockpit resource management training, simulation, low-cost training aids and devices, pilot education and safety awareness programs, innovative uses of aircraft for flight training, and innovative approaches to recurrent training for regional airline aircrews.					
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